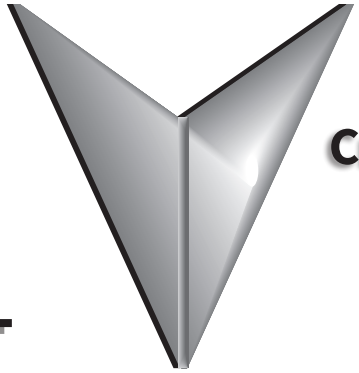
Chapter 4: AC Drive Parameters



Chapter 4

Table of Contents

AC Drive Parameters

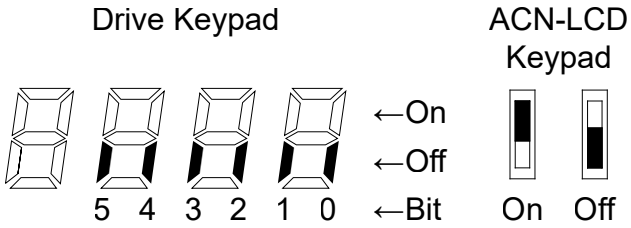
This chapter covers all the parameters available for use with the Ironhorse ACN series drives. The "Parameter Summary" section provides a table of all the parameters with basic information. The "Parameter Details" section provides explanation about each parameter and how they interact with other parameters.

Set the parameters required according to the following chapter. If a set value input is out of range or not allowed, the following messages can be shown on the keypad display. In these cases, the parameter value will not be accepted with the [ENT] key.

- ***rd**: Set value not allocated (reserved)*
- ***OL**: Set value repetition (multi–function input, PID reference, PID feedback related)*
- ***no**: Set value not allowed (select value, V2, I2)*

Bit Selection

Bit level selections are displayed as follows:



Use the left/right arrows to move bits. Use up/down arrows to toggle bits on/off.

Parameter Table Format Explanation

The ACN drive has 14 parameter groups containing over 700 parameters. The LCD keypad allows for 2 additional parameter menus.

Parameter Group								
Pr. Code	Name	Setting Range	Initial Value	Run R/W	Parameter Dependency	Compatible Control Mode	Comm. Address (Hex)	Ref.

Table Legend

- ***Code** – Parameter display group and number shown on the drive keypad*
- ***Name** – Parameter description*
- ***Setting Range** – Range of parameter settings, including units if applicable*
- ***Initial Value** – Parameter default setting*
- ***Run R/W***
  - » *♦R/W – Parameter Write–enabled during Operation (Run mode)*
  - » *R/W – Parameter Write–enabled when stopped*
  - » *Parameter Read Only*
- ***Parameter Dependency** – Indicates a parameter is available only when this criteria is met. If blank, the parameter has no additional dependency.*
- ***Compatible Control Mode** – Indicates a parameter is available in these control modes only. Control mode is set by Parameter dr.9.*
  - » *"v" – v/f (dr.9 =0)*
  - » *"s" – slip compensation (dr.9 = 2)*
  - » *"i" – IM Sensorless (dr.9 = 4)*
  - » *"p" – PM Sensorless (dr.9 = 6)*
- ***Comm. Addresses** – Hexadecimal and Modbus decimal parameter address for serial communications.*
- ***Ref.** – Page reference and link to parameter details.*

Parameter Group Summary			
Parameter Group Display Code		Description	Parameter Pr. Group Dependency
Drive Keypad LED (Built in) 	Remote LCD (optional) 		
"use up/down arrows at 0.0. (No code)"	n/a	Operation	
dr	DRV	Drive	
bA	BAS	Basic	
Ad	ADV	Advanced	
Cn	CON	Control	
In	IN	Inputs	
OU	OUT	Outputs	
CM	COM	Communication	
AP	APP	Application	
AO*	APO*	Optional I/O Card	*ACN–EIO card is installed
Pr	PRT	Protection	
M2*	M2*	2nd Motor	* In.65–69–> any one of these parameters is set to 26
US*	USS*	User Sequence	*AP.2 =1 or CM.95=1 (P2P Master)
UF*	USF*	User Sequence Function	*AP.2 =1 or CM.95=1 (P2P Master)
n/a	CNF	Configuration	LCD only
n/a	TRP	Trip	LCD only

Operation Parameter Group

The Operation group is used only on the standard drive keypad. It will not be displayed on an LCD keypad (ACN–LCD). If the LCD keypad is connected, the corresponding functions will be found in the Drive parameter group.

See "Table Legend" on page 4–3 for details on each column in the table below.

Operation Parameter Group									
Pr. Code	Name	Setting Range		Initial Value	Run R/W	Parameter Dependency	Compatible Control Mode	Comm. Address (Hex)	Ref.
0.00	Target frequency	0–Maximum frequency(Hz)		0.00	♦R/W	–	v, s, i, p	0h1F00	3–5
ACC	Acceleration time	0.0–600.0s		20.0	♦R/W	–	v, s, i, p	0h1F01	4–87
dEC	Deceleration time	0.0–600.0s		30.0	♦R/W	–	v, s, i, p	0h1F02	4–87
drv	Command source	0	Keypad	1: Fx/Rx–1 (Fwd Run/ Rev Run)	R/W	–	v, s, i, p	0h1F03	4–79
		1	Fx/Rx–1 (Fwd Run/ Rev Run)						
		2	Fx/Rx–2 (Run/ Direction)						
		3	Int 485						
		4	Field Bus[1]						
		5	UserSeqLink						
Frq	Frequency reference source	0	Keypad–1	0: Keypad–1	R/W	–	v, s, i, p	0h1F04	4–68
		1	Keypad–2						
		2	V1						
		4	V2						
		5	I2						
		6	Int 485						
		8	Field Bus						
		12	Pulse						
		13	V3						
		15	V4						
		16	I4						
St1	Multi–step speed frequency 1	0.00–Maximum frequency(Hz)		10.00	♦R/W	–	v, s, i, p	0h1F05	4–77
St2	Multi–step speed frequency 2	0.00–Maximum frequency(Hz)		20.00	♦R/W	–	v, s, i, p	0h1F06	4–77
St3	Multi–step speed frequency 3	0.00–Maximum frequency(Hz)		30.00	♦R/W	–	v, s, i, p	0h1F07	4–77
CUr	Output current	–		–	Read Only	–	v, s, i, p	0h1F08	3–17
Rpm	Motor revolutions per minute	–		–	Read Only	–	v, s, i, p	0h1F09	–
dCL	Drive direct current voltage	–		–	Read Only	–	v, s, i, p	0h1F0A	3–17
vOL	Drive output voltage	–		–	Read Only	–	v, s, i, p	0h1F0B	3–17
nOn	Out of order signal	–		–	–	–	v, s, i, p	0h1F0C	–

Operation Parameter Group									
Pr. Code	Name	Setting Range		Initial Value	Run R/W	Parameter Dependency	Compatible Control Mode	Comm. Address (Hex)	Ref.
drC	Select rotation direction	F	Forward run	F	♦R/W	–	v, s, i, p	0h1F0D	–
		r	Reverse run						

DRIVE PARAMETER GROUP (DR, DRV)

The drive parameter group is labeled as follows:

- *dr – standard LED kepyad*
- *DRV– optional LCD keypad*

See "Table Legend" on page 4–3 for details on each column in the table below.

Drive Parameter Group (dr, DRV)									
Pr. Code	**Name**	**Setting Range**		**Initial Value**	**Run R/W**	**Parameter Dependency**	**Compatible Control Mode**	**Comm. Address (Hex)**	**Ref.**
dr.0	Jump Code	1–99		9	♦R/W	–	v, s, i, p	–	3–5
dr.1	Target (CMD) frequency	Start frequency – Maximum frequency (Hz)		0.00	♦R/W	LCD only. +	v, s, i, p	0h1101	3–10
dr.2	Torque command	–180–180%		0.0	♦R/W	dr.9=4	i	0h1102	4–164
dr.3	Acceleration time	0.0–600.0s		20.0	♦R/W	LCD only. +	v, s, i, p	0h1103	4–87
dr.4	Deceleration time	0.0–600.0s		30.0	♦R/W	LCD only. +	v, s, i, p	0h1104	4–87
dr.6	Command source	0	Keypad	1: Fx/Rx–1 (Fwd Run/ Rev Run)	R/W	LCD only. +	v, s, i, p	0h1106	4–79
		1	Fx/Rx–1 (Fwd Run/Rev Run)						
		2	Fx/Rx–2 (Run/Direction)						
		3	Int 485						
		4	Field Bus						
		5	UserSeqLink						
dr.7	Frequency reference source	0	Keypad–1	0: Keypad–1	R/W	LCD only. +	v, s, i, p	0h1107	4–68
		1	Keypad–2						
		2	V1						
		4	V2						
		5	I2						
		6	Int 485						
		8	Field Bus						
		9	UserSeqLink						
		12	Pulse						
		13	V3						
		15	V4						
		16	I4						

+ View this parameter in the Operation menu group if LCD is not installed
 # View this parameter in CNF menu on ACN-LCD keypad

Drive Parameter Group (dr, DRV)									
Pr. Code	**Name**	**Setting Range**		**Initial Value**	**Run R/W**	**Parameter Dependency**	**Compatible Control Mode**	**Comm. Address (Hex)**	**Ref.**
dr.8	Torque reference setting	0	Keypad–1	0: Keypad–1	R/W	dr.9=4	i	0h1108	4–164
		1	Keypad–2						
		2	V1						
		4	V2						
		5	I2						
		6	Int 485						
		8	FieldBus (Ethernet)						
		9	UserSeqLink						
		12	Pulse						
		13	V3						
		15	V4						
		16	I4						
dr.9	Control mode	0	V/F	0: V/F	R/W	–	v, s, i, p	0h1109	4–93 4–138 4–148
		2	Slip Compen						
		4	IM Sensorless						
		6	PM Sensorless						
dr.10	Torque Control	0	No	0: No	R/W	dr.9=4	i	0h110A	4–164
		1	Yes						
dr.11	Jog frequency	0.00, Start frequency–Maximum frequency(Hz)		10.00	♦R/W	–	v, s, i, p	0h110B	4–129
dr.12	Jog run acceleration time	0.0–600.0s		20.0	♦R/W	–	v, s, i, p	0h110C	4–129
dr.13	Jog run deceleration time	0.0–600.0s		30.0	♦R/W	–	v, s, i, p	0h110D	4–129
dr.14	Motor capacity	0	0.2kW	Varies by Drive capacity	R/W	–	v, s, i, p	0h110E	4–146
		1	0.4kW						
		2	0.75kW						
		3	1.1kW						
		4	1.5kW						
		5	2.2kW						
		6	3.0kW						
		7	3.7kW						
		8	4.0kW						
		9	5.5kW						
		10	7.5kW						
		11	11.0kW						
		12	15.0kW						
		13	18.5kW						
		14	22.0kW						
		15	30.0kW						

+ View this parameter in the Operation menu group if LCD is not installed
 # View this parameter in CNF menu on ACN-LCD keypad

Drive Parameter Group (dr, DRV)									
Pr. Code	**Name**	**Setting Range**		**Initial Value**	**Run R/W**	**Parameter Dependency**	**Compatible Control Mode**	**Comm. Address (Hex)**	**Ref.**
dr.15	Torque boost options	0	Manual	0: Manual	R/W	–	v, s	0h110F	–
		1	Auto1						
		2	Auto2						
dr.16	Forward Torque boost	0.0–15.0%		2.0	R/W	–	v, s	0h1110	4–97
dr.17	Reverse Torque boost	0.0–15.0%		2.0	R/W	–	v, s	0h1111	4–97
dr.18	Base frequency	30.00–400.00 Hz [V/F, Slip Compen] 40.00–120.00 Hz [IM Sensorless] 30.00–180.00 Hz [PM Sensorless]		60.00	R/W	–	v, s, i, p	0h1112	4–93
dr.19	Start frequency	0.01–10.00Hz		0.50	R/W	–	v, s, i, p	0h1113	4–93
dr.20	Maximum frequency	40.00–400.00 Hz [V/F, Slip Compen] 40.00–120.00 Hz [IM Sensorless] 40.00–180.00 Hz [PM Sensorless]		60.00	R/W	–	v, s, i, p	0h1114	4–102
dr.21	Select speed unit	0	Hz Display	0: Hz Display	♦R/W	LCD Only	v, s, i, p	0h1115	4–77
		1	Rpm Display						
dr.22	(+)Torque gain	50.0 – 150.0%		100.0	♦R/W	dR.10=1	i	0h1116	4–164
dr.23	(–)Torque gain	50.0 – 150.0%		80.0	♦R/W	dR.10=1	i	0h1117	4–164
dr.24	(–)Torque gain 0	50.0 – 150.0%		80.0	♦R/W	dR.10=1	i	0h1118	4–164
dr.25	(–)Torque offset	0.0 – 100.0%		40.0	♦R/W	dR.10=1	i	0h1119	4–164

+ View this parameter in the Operation menu group if LCD is not installed
 # View this parameter in CNF menu on ACN-LCD keypad

Drive Parameter Group (dr, DRV)									
Pr. Code	**Name**	**Setting Range**		**Initial Value**	**Run R/W**	**Parameter Dependency**	**Compatible Control Mode**	**Comm. Address (Hex)**	**Ref.**
dr.80	Select ranges at power input	Select ranges drive displays at power input		0: Run frequency	♦R/W	LED keypad only #	v, s, i, p	0h1150	–
		0	Run frequency						
		1	Acceleration time						
		2	Deceleration time						
		3	Command source						
		4	Frequency reference source						
		5	Multi–step speed frequency1						
		6	Multi–step speed frequency2						
		7	Multi–step speed frequency3						
		8	Output current						
		9	Motor RPM						
		10	Drive DC voltage						
		11	User select signal (dr.81)						
		12	Currently out of order						
		13	Select run direction						
		14	Output current2						
		15	Motor RPM2						
		16	Drive DC voltage2						
		17	User select signal2 (dr.81)						
dr.81	Select monitor code	Monitors user selected code		0: Output voltage	♦R/W	LED keypad only #	v, s, i, p	0h1151	–
		0	Output voltage(V)						
		1	Output electric power (kW)						
		2	Torque (kg f*m)						
dr.89	Display changed parameter	0	View All	0: View All	♦R/W	LED keypad only #	v, s, i, p	0h03E3	4–180
		1	View Changed						
dr.90	[ESC] key functions	0	Move to initial position	0: None	R/W	LED keypad only #	v, s, i, p	0h115A	3–9 4–82 4–131
		1	JOG Key						
		2	Local/Remote						
dr.91	Smart copy	0	None	0: None	R/W	LED keypad only #	v, s, i, p	0h115B	–
		1	Not Supported						
		3	Not Supported						

+ View this parameter in the Operation menu group if LCD is not installed
 # View this parameter in CNF menu on ACN-LCD keypad

Drive Parameter Group (dr, DRV)									
Pr. Code	**Name**	**Setting Range**		**Initial Value**	**Run R/W**	**Parameter Dependency**	**Compatible Control Mode**	**Comm. Address (Hex)**	**Ref.**
dr.93	Parameter initialization	0	No	0: No	R/W	LED keypad only #	v, s, i, p	0h115D	4–177
		1	All Grp						
		2	dr Grp						
		3	bA Grp						
		4	Ad Grp						
		5	Cn Grp						
		6	In Grp						
		7	OU Grp						
		8	CM Grp						
		9	AP Grp						
		11	APO Grp						
		12	Pr Grp						
		13	M2 Grp						
		14	US Grp						
		15	UF Grp						
		16	SPS Grp (Operation)						
dr.94	Password registration	0–9999		–	♦R/W	LED keypad only #	v, s, i, p	0h115E	4–178
dr.95	Parameter lock settings	0–9999		–	♦R/W	LED keypad only #	v, s, i, p	0h115F	4–179
dr.97	Software version	–		–	Read Only	LED keypad only #	v, s, i, p	0h1161	–
dr.98	Display I/O board version	–		–	Read Only	–	v, s, i, p	0h1162	–
dr.99	Display I/O board H/W version	1	Standard IO	1: Standard IO	Read Only	–	v, s, i, p	0h1163	–

+ View this parameter in the Operation menu group if LCD is not installed
 # View this parameter in CNF menu on ACN-LCD keypad

BASIC Parameter group (bA, BAS)

The BASIC parameter group is labeled as follows:

- *bA – standard LED kepyad*
- *BAS– optional LCD keypad*

See "Table Legend" on page 4–3 for details on each column in the table below.

BASIC Parameter group (bA, BAS)									
Pr. Code	**Name**	**Setting Range**		**Initial Value**	**Run R/W**	**Parameter Dependency**	**Compatible Control Mode**	**Comm. Address (Hex)**	**Ref.**
bA.0	Jump Code	1–99		20	♦R/W	–	v, s, i, p	–	3–5
bA.1	Auxiliary reference source	0	None	0: None	R/W	–	v, s, i, p	0h1201	4–126
		1	V1						
		3	V2						
		4	I2						
		6	Pulse						
		7	V3						
		9	V4						
		10	I4						
bA.2	Auxiliary command calculation type	0	M+(G*A)	0: M+(G*A)	R/W	bA.1≠0	v, s, i, p	0h1202	4–126
		1	Mx (G*A)						
		2	M/(G*A)						
		3	M+[M*(G*A)]						
		4	M+G*2(A–50%)						
		5	Mx[G*2(A–50%)						
		6	M/[G*2(A–50%)]						
		7	M+M*G*2 (A–50%)						
bA.3	Auxiliary command gain	–200.0–200.0%		100.0	♦R/W	bA.1≠0	v, s, i, p	0h1203	4–126
bA.4	2nd command source	0	Keypad	1: Fx/Rx–1 (Fwd Run/ Rev Run)	R/W	–	v, s, i, p	0h1204	4–104
		1	Fx/Rx–1 (Fwd Run/Rev Run)						
		2	Fx/Rx–2 (Run/Direction)						
		3	Int 485						
		4	FieldBus (Ethernet)						

BASIC Parameter group (bA, BAS)									
Pr. Code	Name	Setting Range		Initial Value	Run R/W	Parameter Dependency	Compatible Control Mode	Comm. Address (Hex)	Ref.
bA.5	2nd frequency source	0	Keypad–1	0: Keypad–1	♦R/W	–	v, s, i, p	0h1205	4–104
		1	Keypad–2						
		2	V1						
		4	V2						
		5	I2						
		6	Int 485						
		8	FieldBus (Ethernet)						
		9	UserSeqLink						
		12	Pulse						
		13	V3						
		15	V4						
		16	I4						
bA.6	2nd Torque command source	0	Keypad–1	0: Keypad–1	♦R/W	–	i	0h1206	–
		1	Keypad–2						
		2	V1						
		4	V2						
		5	I2						
		6	Int 485						
		8	FieldBus (Ethernet)						
		9	UserSeqLink						
		12	Pulse						
		13	V3						
		15	V4						
		16	I4						
bA.7	V/F pattern options	0	Linear	0: Linear	R/W	–	v, s	0h1207	4–93
		1	Square						
		2	User V/F						
		3	Square 2						
bA.8	Acc/dec standard frequency	0	Max Freq	0: Max Freq	R/W	–	v, s, i, p	0h1208	4–87
		1	Delta Freq						
bA.9	Time scale settings	0	0.01 sec	1: 0.1 sec	R/W	–	v, s, i, p	0h1209	4–87
		1	0.1 sec						
		2	1 sec						
bA.10	Input power frequency	0	60Hz	0: 60Hz	R/W	–	v, s, i, p	0h120A	4–177
		1	50Hz						
bA.11	Number of motor poles	2–48		Dependent on motor setting	R/W	–	v, s, i, p	0h120B	4–138
bA.12	Rated slip speed	0–3000(Rpm)		Dependent on motor setting	R/W	dr.9≠6 not PM sensorless	v, s, i	0h120C	4–138
bA.13	Motor rated current	1.0–1000.0A		Dependent on motor setting	R/W	–	v, s, i, p	0h120D	4–138

BASIC Parameter group (bA, BAS)								
Pr. Code	Name	Setting Range	Initial Value	Run R/W	Parameter Dependency	Compatible Control Mode	Comm. Address (Hex)	Ref.
bA.14	Motor no load current	0.0–1000.0A	Dependent on motor setting	R/W	dr.9≠6 not PM sensorless	v, s, i	0h120E	4–138
bA.15	Motor rated voltage	170–480V	Dependent on motor setting	R/W	–	v, s, i, p	0h120F	4–98
bA.16	Motor efficiency	64–100%	Dependent on motor setting	R/W	–	v, s, i, p	0h1210	4–138
bA.17	Load inertia rate	0–8	0	R/W	–	v, s, i, p	0h1211	4–138
bA.18	Trim power display	70–130%	100	♦R/W	–	v, s, i, p	0h1212	–
bA.19	Input power voltage	230V : 170–240V	220	♦R/W	–	v, s, i, p	0h1213	4–177
		460V : 320–480V	380					
bA.20	Auto Tuning	0 None 1 All (Rotation type) 2 ALL (Static type) 3 Rs+Lsigma (Rotation type) 6 Tr (Static type) 7 All PM	0: None	R/W	–	i, p	–	4–146
bA.21	Stator resistance	Dependent on motor setting	Dependent on motor setting	R/W	–	i, p	–	4–146
bA.22	Leakage inductance	–	Dependent on motor setting	R/W	dr.9≠6 not PM sensorless	i	–	4–146
bA.23	Stator inductance	–	Dependent on motor setting	R/W	dr.9≠6 not PM sensorless	i	–	4–146
bA.24	Rotor time constant	25–5000(ms)	Dependent on motor setting	R/W	dr.9=4 IM Sensorless	i	–	4–146
bA.25	Stator inductance scale	50 – 150%	100	R/W	dr.9=4 IM Sensorless	i	–	–
bA.26	Rotor time constant scale	50 – 150%	100	R/W	dr.9=4 IM Sensorless	i	–	–
bA.28	D–axis inductance	Settings vary depending on the motor specifications.	0	R/W	dr.9=6 PM Sensorless	p	–	–
bA.29	Q–axis inductance	Settings vary depending on the motor specifications.	0	R/W	dr.9=6 PM Sensorless	p	–	–
bA.30	Flux reference	Settings vary depending on the motor specifications.	0.147	R/W	dr.9=6 PM Sensorless	p	–	–
bA.31	Regeneration inductance scale	70 – 100%	80	R/W	dr.9=4 IM Sensorless	i	–	–
bA.32	Q–axis inductance scale	50–150%	100	R/W	dr.9=6 PM Sensorless	p	–	–

BASIC Parameter group (bA, BAS)								
Pr. Code	Name	Setting Range	Initial Value	Run R/W	Parameter Dependency	Compatible Control Mode	Comm. Address (Hex)	Ref.
bA.34	PM auto tuning level	20.0–50.0%	33	R/W	dr.9=6 PM Sensorless	p	–	–
bA.35	PM auto tuning frequency	80.0–150.0%	150	R/W	dr.9=6 PM Sensorless	p	–	–
bA.41	User frequency1	0.00–Maximum frequency(Hz)	15.00	R/W	bA.7 or m2.25=2	v, s	0h1229	4–95
bA.42	User voltage1	0–100%	25	R/W	bA.7 or m2.25=2	v, s	0h122A	4–95
bA.43	User frequency2	0.00–0.00– Maximum frequency(Hz)	30.00	R/W	bA.7 or m2.25=2	v, s	0h122B	4–95
bA.44	User voltage2	0–100%	50	R/W	bA.7 or m2.25=2	v, s	0h122C	4–95
bA.45	User frequency3	0.00–Maximum frequency(Hz)	45.00	R/W	bA.7 or m2.25=2	v, s	0h122D	4–95
bA.46	User voltage3	0–100%	75	R/W	bA.7 or m2.25=2	v, s	0h122E	4–95
bA.47	User frequency4	0.00–Maximum frequency(Hz)	Maximum frequency	R/W	bA.7 or m2.25=2	v, s	0h122F	4–95
bA.48	User voltage4	0–100%	100	R/W	bA.7 or m2.25=2	v, s	0h1230	4–95
bA.50	Multi–step speed frequency1	0.00–Maximum frequency(Hz)	10.00	♦R/W	LCD Only	v, s, i, p	0h1232	4–77
bA.51	Multi–step speed frequency2	0.00–Maximum frequency(Hz)	20.00	♦R/W	LCD Only	v, s, i, p	0h1233	4–77
bA.52	Multi–step speed frequency3	0.00–Maximum frequency(Hz)	30.00	♦R/W	LCD Only	v, s, i, p	0h1234	4–77
bA.53	Multi–step speed frequency4	0.00–Maximum frequency(Hz)	40.00	♦R/W	In.65–71= Spd–L/M/H	v, s, i, p	0h1235	4–77
bA.54	Multi–step speed frequency5	0.00–Maximum frequency(Hz)	50.00	♦R/W	In.65–71= Spd–L/M/H	v, s, i, p	0h1236	4–77
bA.55	Multi–step speed frequency6	0.00–Maximum frequency(Hz)	Maximum frequency	♦R/W	In.65–71= Spd–L/M/H	v, s, i, p	0h1237	4–77
bA.56	Multi–step speed frequency7	0.00–Maximum frequency(Hz)	Maximum frequency	♦R/W	In.65–71= Spd–L/M/H	v, s, i, p	0h1238	4–77
bA.70	Multi–step acceleration time1	0.0–600.0s	20.0	♦R/W	–	v, s, i, p	0h1246	4–88
bA.71	Multi–step deceleration time1	0.0–600.0s	20.0	♦R/W	–	v, s, i, p	0h1247	4–88
bA.72	Multi–step acceleration time2	0.0–600.0s	30.0	♦R/W	In.65–71= Xcel–L/M/H	v, s, i, p	0h1248	4–88

BASIC Parameter group (bA, BAS)								
Pr. Code	Name	Setting Range	Initial Value	Run R/W	Parameter Dependency	Compatible Control Mode	Comm. Address (Hex)	Ref.
bA.73	Multi–step deceleration time2	0.0–600.0s	30.0	♦R/W	In.65–71= Xcel–L/M/H	v, s, i, p	0h1249	4–88
bA.74	Multi–step acceleration time3	0.0–600.0s	40.0	♦R/W	In.65–71= Xcel–L/M/H	v, s, i, p	0h124A	4–88
bA.75	Multi–step deceleration time3	0.0–600.0s	40.0	♦R/W	In.65–71= Xcel–L/M/H	v, s, i, p	0h124B	4–88
bA.76	Multi–step acceleration time4	0.0–600.0s	50.0	♦R/W	In.65–71= Xcel–L/M/H	v, s, i, p	0h124C	4–88
bA.77	Multi–step deceleration time4	0.0–600.0s	50.0	♦R/W	In.65–71= Xcel–L/M/H	v, s, i, p	0h124D	4–88
bA.78	Multi–step acceleration time5	0.0–600.0s	40.0	♦R/W	In.65–71= Xcel–L/M/H	v, s, i, p	0h124E	4–88
bA.79	Multi–step deceleration time5	0.0–600.0s	40.0	♦R/W	In.65–71= Xcel–L/M/H	v, s, i, p	0h124F	4–88
bA.80	Multi–step acceleration time6	0.0–600.0s	30.0	♦R/W	In.65–71= Xcel–L/M/H	v, s, i, p	0h1250	4–88
bA.81	Multi–step deceleration time6	0.0–600.0s	30.0	♦R/W	In.65–71= Xcel–L/M/H	v, s, i, p	0h1251	4–88
bA.82	Multi–step acceleration time7	0.0–600.0s	20.0	♦R/W	In.65–71= Xcel–L/M/H	v, s, i, p	0h1252	4–88
bA.83	Multi–step deceleration time7	0.0–600.0s	20.0	♦R/W	In.65–71= Xcel–L/M/H	v, s, i, p	0h1253	4–88

ADVANCED Parameter group (Ad, ADV)

The ADVANCED parameter group is labeled as follows:

- *Ad – standard LED kepyad*
- *ADV– optional LCD keypad*

See "Table Legend" on page 4–3 for details on each column in the table below.

ADVANCED Parameter Group (Ad, ADV)									
Pr. Code	Name	Setting Range		Initial Value	Run R/W	Parameter Dependency	Compatible Control Mode	Comm. Address (Hex)	Ref.
Ad.0	Jump Code	1–99		24	♦R/W	–	v, s, i, p	–	3–5
Ad.1	Acceleration pattern	0	Linear	0: Linear	R/W	–	v, s, i, p	0h1301	4–91
		1	S–curve						
Ad.2	Deceleration pattern	0	Linear	0: Linear	R/W	–	v, s, i, p	0h1302	4–91
		1	S–curve						
Ad.3	S–curve acceleration start point gradient	1–100%		40	R/W	Ad.1=1	v, s, i, p	0h1303	4–91
Ad.4	S–curve acceleration end point gradient	1–100%		40	R/W	Ad.1=1	v, s, i, p	0h1304	4–91
Ad.5	S–curve deceleration start point gradient	1–100%		40	R/W	Ad.2=1	v, s, i, p	0h1305	4–91
Ad.6	S–curve deceleration end point gradient	1–100%		40	R/W	Ad.2=1	v, s, i, p	0h1306	4–91
Ad.7	Start Mode	0	Acc	0: Acc	R/W	–	v, s, i, p	0h1307	4–98
		1	DC–Start						
Ad.8	Stop Mode	0	Dec	0: Dec	R/W	–	v, s, i, p	0h1308	4–99
		1	DC–Brake			dr.9≠6			
		2	Free–Run			–			
		4	Power Braking			dr.9≠6			
Ad.9	Selection of prohibited rotation direction	0	None	0: None	R/W	–	v, s, i, p	0h1309	4–84
		1	Forward Prev						
		2	Reverse Prev						
Ad.10	Starting with power on	0	No	0: No	♦R/W	–	v, s, i, p	0h130A	4–85
		1	Yes						
Ad.12	DC braking time at startup	0.00–60.00s		0.00	R/W	Ad.7=1	v, s, i, p	0h130C	4–98
Ad.13	Amount of applied DC	0–200%		50	R/W	–	v, s, i, p	0h130D	4–98
Ad.14	Output blocking time before DC braking	0.00– 60.00s		0.10	R/W	Ad.8=1	v, s, i, p	0h130E	4–99
Ad.15	DC braking time	0.00– 60.00s		1.00	R/W	Ad.8=1	v, s, i, p	0h130F	4–99
Ad.16	DC braking rate	0–200%		50	R/W	Ad.8=1	v, s, i, p	0h1310	4–99
Ad.17	DC braking frequency	Start frequency–60 Hz		5.00	R/W	Ad.8=1	v, s, i, p	0h1311	4–99
Ad.20	Dwell frequency on acceleration	Start frequency–Maximum frequency(Hz)		5.00	R/W	–	v, s, i, p	0h1314	4–136

ADVANCED Parameter Group (Ad, ADV)									
Pr. Code	Name	Setting Range		Initial Value	Run R/W	Parameter Dependency	Compatible Control Mode	Comm. Address (Hex)	Ref.
Ad.21	Dwell operation time on acceleration	0.0–60.0s		0.0	R/W	–	v, s, i, p	0h1315	4–136
Ad.22	Dwell frequency on deceleration	Start frequency–Maximum frequency(Hz)		5.00	R/W	–	v, s, i, p	0h1316	4–136
Ad.23	Dwell operation time on deceleration	0.0–60.0s		0.0	R/W	–	v, s, i, p	0h1317	4–136
Ad.24	Frequency limit	0	No	0: No	R/W	–	v, s, i, p	0h1318	4–102
		1	Yes						
Ad.25	Frequency lower limit value	0.00–Upper limit frequency(Hz)		0.50	♦R/W	Ad.24=1	v, s, i, p	0h1319	4–102
Ad.26	Frequency upper limit value	Lower limit frequency–Maximum frequency(Hz)		maximum frequency	R/W	Ad.24=1	v, s, i, p	0h131A	4–102
Ad.27	Frequency jump	0	No	0: No	R/W	–	v, s, i, p	0h131B	4–103
		1	Yes						
Ad.28	Jump frequency lower limit1	0.00–Jump frequency upper limit1Hz		10.00	♦R/W	Ad.27=1	v, s, i, p	0h131C	4–103
Ad.29	Jump frequency upper limit1	Jump frequency lower limit1–Maximum frequency(Hz)		15.00	♦R/W	Ad.27=1	v, s, i, p	0h131D	4–103
Ad.30	Jump frequency lower limit2	0.00–Jump frequency upper limit2Hz		20.00	♦R/W	Ad.27=1	v, s, i, p	0h131E	4–103
Ad.31	Jump frequency upper limit2	Jump frequency lower limit2–Maximum frequency(Hz)		25.00	♦R/W	Ad.27=1	v, s, i, p	0h131F	4–103
Ad.32	Jump frequency lower limit3	0.00–Jump frequency upper limit3Hz		30.00	♦R/W	Ad.27=1	v, s, i, p	0h1320	4–103
Ad.33	Jump frequency upper limit3	Jump frequency lower limit3–Maximum frequency(Hz)		35.00	♦R/W	Ad.27=1	v, s, i, p	0h1321	4–103
Ad.41	Brake release current	0.0–180.0%		50.0	♦R/W	OU.31 or OU.33 = 35	v, s, i, p	0h1329	4–184
Ad.42	Brake release delay time	0.00–10.00s		1.00	R/W	OU.31 or OU.33 = 35	v, s, i, p	0h132A	4–184
Ad.44	Brake release Forward frequency	0.00–Maximum frequency(Hz)		1.00	R/W	OU.31 or OU.33 = 35	v, s, i, p	0h132C	4–184
Ad.45	Brake release Reverse frequency	0.00–Maximum frequency(Hz)		1.00	R/W	OU.31 or OU.33 = 35	v, s, i, p	0h132D	4–184
Ad.46	Brake engage delay time	0.00–10.00s		1.00	R/W	OU.31 or OU.33 = 35	v, s, i, p	0h132E	4–184
Ad.47	Brake engage frequency	0.00–Maximum frequency(Hz)		2.00	R/W	OU.31 or OU.33 = 35	v, s, i, p	0h132F	4–184
Ad.50	Energy saving operation	0	None	0: None	R/W	–	v, s	0h1332	4–168
		1	Manual						
		2	Auto						
Ad.51	Energy saving level	0–30%		0	♦R/W	Ad.50≠0	v, s	0h1333	4–168
Ad.60	Acc/Dec time switch frequency	0.00–Maximum frequency(Hz)		0.00	R/W	–	v, s, i, p	0h133C	4–89

ADVANCED Parameter Group (Ad, ADV)									
Pr. Code	Name	Setting Range		Initial Value	Run R/W	Parameter Dependency	Compatible Control Mode	Comm. Address (Hex)	Ref.
Ad.61	Rotation count speed gain	0.1–6000.0%		100.0	♦R/W	–	v, s, i, p	0h133D	–
Ad.62	Rotation count speed scale	0	x 1	0: x 1	♦R/W	–	v, s, i, p	0h133E	–
		1	x 0.1						
		2	x 0.01						
		3	x 0.001						
		4	x 0.0001						
Ad.63	Rotation count speed unit	0	Rpm	0: rpm	♦R/W	–	v, s, i, p	0h133F	–
		1	mpm						
Ad.64	Cooling fan control	0	During Run	0: During Run	♦R/W	–	v, s, i, p	0h1340	4–177
		1	Always ON						
		2	Temp Control						
Ad.65	Up/down operation frequency save	0	No	0: No	♦R/W	–	v, s, i, p	0h1341	4–132
		1	Yes						
Ad.66	Output contact On/ Off control options	0	None	0: None	R/W	–	v, s, i, p	0h1342	4–185
		1	V1						
		3	V2						
		4	I2						
		6	Pulse						
		7	V3						
		9	V4						
		10	I4						
Ad.67	Output contact On level	Output contact off level–100.00%		90.00	R/W	–	v, s, i, p	0h1343	4–185
Ad.68	Output contact Off level	–100.00–output contact on level (%)		10.00	R/W	–	v, s, i, p	0h1344	4–185
Ad.70	Safe operation selection	0	Always Enable	0: Always Enable	R/W	–	v, s, i, p	0h1346	4–135
		1	DI Dependent						
Ad.71	Safe operation stop options	0	Free–Run	0: Free–Run	R/W	Ad.70=1	v, s, i, p	0h1347	4–135
		1	Q–Stop						
		2	Q–Stop Resume						
Ad.72	Safe operation deceleration time	0.0–600.0s		5.0	♦R/W	Ad.70=1	v, s, i, p	0h1348	4–135
Ad.74	Selection of regeneration evasion function for press	0	No	0: No	R/W	dr.9≠6	v, s, i	0h134A	4–185
		1	Yes						
Ad.75	Voltage level of regeneration evasion motion for press	230V : 300–400V		350	R/W	dr.9≠6	v, s, i	0h134B	4–185
		460V : 600–800V		700					
Ad.76	Compensation frequency limit of regeneration evasion for press	0.00– 10.00Hz		1.00	R/W	Ad.74=1	v, s, i	0h134C	4–185

ADVANCED Parameter Group (Ad, ADV)									
Pr. Code	Name	Setting Range		Initial Value	Run R/W	Parameter Dependency	Compatible Control Mode	Comm. Address (Hex)	Ref.
Ad.77	Regeneration evasion for press P gain	0.0– 100.0%		50.0	♦R/W	Ad.74=1	v, s, i	0h134D	4–185
Ad.78	Regeneration evasion for press I gain	20–30000(ms)		500	♦R/W	Ad.74=1	v, s, i	0h134E	4–185
Ad.79	Dynamic Brake (DB) Unit turn on voltage level	230V: 350–400V		390V	R/W	–	v, s, i, p	0h134F	4–207
		460V: 600–800V		780V					
Ad.80	Fire mode selection	0	None	0: None	R/W	–	v, s, i, p	0h1350	4–123
		1	Fire Mode						
		2	Fire Mode Test						
Ad.81	Fire mode frequency	0.00–60.00(Hz)		60.00	R/W	Ad.80=1	v, s, i, p	0h1351	4–123
Ad.82	Fire mode direction	0	Forward	0: Forward	R/W	Ad.80=1	v, s, i, p	0h1352	4–123
		1	Reverse						
Ad.83	Fire Mode Count	Can not be modified		–	Read Only	Ad.80=1	v, s, i, p	–	4–123
Ad.85	Up–down mode selection	0	U/D Normal	0: U/D Normal	R/W	–	v, s, i, p	0h1355	4–132
		1	U/D Step						
		2	U/D Step+ Norm						
Ad.86	Up–down step frequency	0–maxFreq		0	♦R/W	–	v, s, i, p	0h1356	4–132
Ad.87	Overmodulation mode selection	0	No	0: No	R/W	–	v, s	0h1357	
		1	Yes						

CONTROL Parameter Group (Cn, CON)

The CONTROL parameter group is labeled as follows:

- *Cn – standard LED kepyad*
- *CON – optional LCD keypad*

See "Table Legend" on page 4–3 for details on each column in the table below.

CONTROL Parameter Group (Cn, CON)									
Pr. Code	**Name**	**Setting Range**		**Initial Value**	**Run R/W**	**Parameter Dependency**	**Compatible Control Mode**	**Comm. Address (Hex)**	**Ref.**
Cn.0	Jump Code	1–99		4	♦R/W	–	v, s, i, p	–	3–5
Cn.4	Carrier frequency	Heavy Duty	V/F: 1.0–15.0 (kHz) IM: 2.0–15.0 (kHz) PM: 2.0–10.0 kHz	3.0	R/W	–	v, s, i, p	0h1404	4–173
Cn.5	Switching mode	0	Normal PWM	0: Normal PWM	R/W	–	v, s, i	0h1405	4–173
		1	Lowleakage PWM						
Cn.9	Initial excitation time	0.00–60.00s		1.00	R/W	dr.9≠6	i	0h1409	4–150
Cn.10	Initial excitation amount	100.0–300.0%		100.0	R/W	dr.9≠6	i	0h140A	4–150
Cn.11	Continued operation duration	0.00–60.00s		0.00	R/W	–	i	0h140B	4–150
Cn.12	PM S/L speed controller proportional gain1	0–5000		100	R/W	dr.9=6 PM Sensorless	p	0h140C	4–155
Cn.13	PM S/L speed controller integral gain1	0–5000		150	R/W	dr.9=6 PM Sensorless	p	0h140D	4–155
Cn.15	PM S/L speed controller proportional gain2	0–5000		100	R/W	dr.9=6 PM Sensorless	p	0h140F	4–155
Cn.16	PM S/L speed controller integral gain2	0–9999		150	R/W	dr.9=6 PM Sensorless	p	0h1410	4–155
Cn.20	Sensorless 2nd gain display setting	0	No	0: No	♦R/W	dr.9≠6	i	0h1414	4–150
		1	Yes						
Cn.21	ASR Sensorless speed controller proportional gain1	0–5000%		Dependent on motor setting	♦R/W	dr.9≠6	i	0h1415	4–150
Cn.22	ASR Sensorless speed controller integral gain1	10–9999(ms)		Dependent on motor setting	♦R/W	dr.9≠6	i	0h1416	4–150
Cn.23	ASR Sensorless speed controller proportional gain2	1.0–1000.0%		Dependent on motor setting	♦R/W	Cn.20=1	i	0h1417	4–150

CONTROL Parameter Group (Cn, CON)								
Pr. Code	Name	Setting Range	Initial Value	Run R/W	Parameter Dependency	Compatible Control Mode	Comm. Address (Hex)	Ref.
Cn.24	ASR Sensorless speed controller integral gain2	1.0–1000.0%	Dependent on motor setting	♦R/W	dr.9= 4 IM Sensorless& Cn.20=1	i	0h1418	4–150
Cn.25	ASR Sensorless speed controller integral gain 0	10–9999(ms)	Dependent on motor setting	♦R/W	dr.9= 4 IM Sensorless& Cn.20=1	i	0h1419	4–150
Cn.26	Flux estimator proportional gain	10–200%	Dependent on motor setting	♦R/W	dr.9= 4 IM Sensorless& Cn.20=1	i	0h141A	4–150
Cn.27	Flux estimator integral gain	10–200%	Dependent on motor setting	♦R/W	dr.9= 4 IM Sensorless& Cn.20=1	i	0h141B	4–150
Cn.28	Speed estimator proportional gain	0–32767	Dependent on motor setting	♦R/W	dr.9= 4 IM Sensorless& Cn.20=1	i	0h141C	4–150
Cn.29	Speed estimator integral gain1	100–1000	Dependent on motor setting	♦R/W	dr.9= 4 IM Sensorless& Cn.20=1	i	0h141D	4–150
Cn.30	Speed estimator integral gain2	100–10000	Dependent on motor setting	♦R/W	dr.9= 4 IM Sensorless& Cn.20=1	i	0h141E	4–150
Cn.31	ACR Sensorless current controller proportional gain	10–1000	Dependent on motor setting	♦R/W	dr.9= 4 IM Sensorless& Cn.20=1	i	0h141F	4–150
Cn.32	ACR Sensorless current controller integral gain	10 –1000	Dependent on motor setting	♦R/W	dr.9= 4 IM Sensorless& Cn.20=1	i	0h1420	4–150
Cn.33	PM D–axis back–EMF estimation gain %	0–300.0%	100.0	R/W	dr.9=6 PM Sensorless	p	0h1421	4–155
Cn.34	PM Q–axis back–EMF estimation gain %	0–300.0%	100.0	R/W	dr.9=6 PM Sensorless	p	0h1422	4–155
Cn.35	Initial pole position detection retry number	0–10	2	R/W	dr.9=6 PM Sensorless	p	0h1423	4–155
Cn.36	Initial pole position detection pulse interval	1–100	20	R/W	dr.9=6 PM Sensorless	p	0h1424	4–155
Cn.37	Initial pole position detection current level %	10–100	15	R/W	dr.9=6 PM Sensorless	p	0h1425	4–155

CONTROL Parameter Group (Cn, CON)								
Pr. Code	Name	Setting Range	Initial Value	Run R/W	Parameter Dependency	Compatible Control Mode	Comm. Address (Hex)	Ref.
Cn.38	Initial pole position detection voltage level %	100–4000	500	R/W	dr.9=6 PM Sensorless	p	0h1426	4–155
Cn.39	PM dead time range %	50.0–100.0	100.0	R/W	dr.9=6 PM Sensorless	p	0h1427	4–155
Cn.40	PM dead time voltage %	50.0–100.0	100.0	R/W	dr.9=6 PM Sensorless	p	0h1428	4–155
Cn.41	Speed estimator P gain1	0–32000	100	R/W	dr.9=6 PM Sensorless	p	0h1429	4–155
Cn.42	Speed estimator I gain1	0–32000	10	R/W	dr.9=6 PM Sensorless	p	0h142A	4–155
Cn.43	Speed estimator P gain2	0–32000	300	R/W	dr.9=6 PM Sensorless	p	0h142B	4–155
Cn.44	Speed estimator I gain2	0–32000	30	R/W	dr.9=6 PM Sensorless	p	0h142C	4–155
Cn.45	Speed estimator feed forward high speed rate %	0–100%	30.0	R/W	dr.9=6 PM Sensorless	p	0h142D	4–155
Cn.46	Initial pole position detection options	0 None 1 Angle Detect 2 Align	1: Angle Detect	R/W	dr.9=6 PM Sensorless	p	0h142E	4–155
Cn.48	Current controller P gain	0–10000	1200	♦R/W	dr.9=6 PM Sensorless	p	1430	4–155
Cn.49	Current controller I gain	0–10000	120	♦R/W	dr.9=6 PM Sensorless	p	1431	4–155
Cn.50	Voltage controller limit	0–100.0%	10.0	R/W	dr.9=6 PM Sensorless	p	0h1432	4–155
Cn.51	Voltage controller I gain	0–1000.0%	10.0	R/W	dr.9=6 PM Sensorless	p	0h1433	4–155
Cn.52	Torque controller output filter	0–2000(ms)	0	R/W	–	i, p	0h1434	4–150

CONTROL Parameter Group (Cn, CON)									
Pr. Code	Name	Setting Range		Initial Value	Run R/W	Parameter Dependency	Compatible Control Mode	Comm. Address (Hex)	Ref.
Cn.53	Torque limit setting options	0	Keypad–1	0: Keypad–1	R/W	–	i, p	0h1435	4–150
		1	Keypad–2						
		2	V1						
		4	V2						
		5	I2						
		6	Int 485						
		8	FieldBus (Ethernet)						
		9	UserSeqLink						
		12	Pulse						
		13	V3						
		15	V4						
		16	I4						
Cn.54	Positive–direction reverse torque limit	0.0–200.0%		150	♦R/W	dr.9= 4 or 6 IM or PM Sensorless	i, p	0h1436	4–150
Cn.55	Positive–direction regeneration torque limit	0.0–200.0%		150	♦R/W	dr.9= 4 or 6 IM or PM Sensorless	i, p	0h1437	4–150
Cn.56	Negative–direction regeneration torque limit	0.0–200.0%		150	♦R/W	dr.9= 4 or 6 IM or PM Sensorless	i, p	0h1438	4–150
Cn.57	Negative–direction reverse torque limit	0.0–200.0%		150	♦R/W	dr.9= 4 or 6 IM or PM Sensorless	i, p	0h1439	4–150
Cn.62	Speed limit Setting	0	Keypad–1	0: Keypad–1	R/W	dr.9=4 IM Sensorless	i, p	0h143E	4–164
		1	Keypad–2						
		2	V1						
		4	V2						
		5	I2						
		6	Int 485						
		7	FieldBus (Ethernet)						
		8	UserSeqLink						
		9	V3						
		11	V4						
		12	I4						
Cn.63	Positive–direction speed limit	0.00– Maximum frequency (Hz)		60.00	♦R/W	dr.9=4 IM Sensorless	i, p	0h143F	4–164
Cn.64	Negative–direction speed limit	0.00– Maximum frequency (Hz)		60.00	♦R/W	dr.9=4 IM Sensorless	i, p	0h1440	4–164
Cn.65	Speed limit operation gain	100–5000%		500	♦R/W	dr.9=4 IM Sensorless	i, p	0h1441	4–164

CONTROL Parameter Group (Cn, CON)									
Pr. Code	Name	Setting Range		Initial Value	Run R/W	Parameter Dependency	Compatible Control Mode	Comm. Address (Hex)	Ref.
Cn.69	PM speed search current	10–100		15	♦R/W	dr.9=6 PM Sensorless	p		4–169
Cn.70	Speed search mode selection	0	Flying Start–1	0: Flying Start–1	R/W	–	v, s	0h1446	4–169
		1	Flying Start–2				v, s, i		
		2	Flying Start–3				p		
Cn.71	Speed search operation selection	bit	0000– 1111	0000	R/W	–	v, s, i, p	0h1447	4–169
		0001	Selection of speed search on acceleration						
		0010	When starting on initialization after fault trip						
		0100	When restarting after instantaneous power interruption						
		1000	When starting with power on						
Cn.72	Speed search reference current	80–200%		150	♦R/W	Cn.70=0	v, s, i, p	0h1448	4–169
Cn.73	Speed search proportional gain	0–9999		Flying Start–1 : 100 Flying Start–2 : 1200	♦R/W	Cn.71. any bit set to 1	v, s, i	0h1449	4–169
Cn.74	Speed search integral gain	0–9999		Flying Start–1 : 200 Flying Start–2 : 1000	♦R/W	Cn.71. any bit set to 1	v, s, i	0h144A	4–169
Cn.75	Output blocking time before speed search	0.0–60.0s		1.0	R/W	Cn.71. any bit set to 1	v, s, i, p	0h144B	4–169
Cn.76	Speed search Estimator gain	50–150%		100	♦R/W	Cn.71. any bit set to 1	v, s, i	0h144C	–
Cn.77	Energy buffering selection	0	No	0: No	R/W	–	v, s, i, p	0h144D	4–162
		1	KEB–1						
		2	KEB–2						
Cn.78	Energy buffering start level	110.0–200.0%		130.0	R/W	Cn.77≠0	v, s, i, p	0h144E	4–162
Cn.79	Energy buffering stop level	Cn.78–210.0%		135.0	R/W	Cn.77≠0	v, s, i, p	0h144F	4–162
Cn.80	Energy buffering P gain	0–20000		1500	♦R/W	Cn.77≠0	v, s, i, p	0h1450	4–162

CONTROL Parameter Group (Cn, CON)								
Pr. Code	Name	Setting Range	Initial Value	Run R/W	Parameter Dependency	Compatible Control Mode	Comm. Address (Hex)	Ref.
Cn.81	Energy buffering I gain	1–20000	500	♦R/W	Cn.77≠0	v, s, i, p	0h1451	4–162
Cn.82	Energy buffering Slip gain	0–2000.0%	30.0	♦R/W	Cn.77≠0	v, s, i	0h1452	4–162
Cn.83	Energy buffering acceleration time	0.0–600.0s	10.0	♦R/W	Cn.77≠0	v, s, i, p	0h1453	4–162
Cn.85	Flux estimator proportional gain1	100–700	370	♦R/W	Cn.20=1	i	0h1455	4–150
Cn.86	Flux estimator proportional gain2	0–100	0	♦R/W	Cn.20=1	i	0h1456	4–150
Cn.87	Flux estimator proportional gain3	0–500	100	♦R/W	Cn.20=1	i	0h1457	4–150
Cn.88	Flux estimator integral gain1	0–200	50	♦R/W	Cn.20=1	i	0h1458	4–150
Cn.89	Flux estimator integral gain2	0–200	50	♦R/W	Cn.20=1	i	0h1459	4–150
Cn.90	Flux estimator integral gain3	0–200	50	♦R/W	Cn.20=1	i	0h145A	4–150
Cn.91	Sensorless voltage compensation1	0–60	Dependent on motor setting	♦R/W	Cn.20=1	i	0h145B	4–150
Cn.92	Sensorless voltage compensation2	0–60	Dependent on motor setting	♦R/W	Cn.20=1	i	0h145C	4–150
Cn.93	Sensorless voltage compensation3	0–60	Dependent on motor setting	♦R/W	Cn.20=1	i	0h145D	4–150
Cn.94	Sensorless field weakening start frequency	80.0–110.0%	100.0	R/W	Cn.20=1	i	0h145E	4–148
Cn.95	Sensorless gain switching frequency	0.00–8.00 Hz	2.00	R/W	Cn.20=1	i	0h145F	4–148

INPUT Parameter Group (In, IN)

The INPUT parameter group is labeled as follows:

- *In – standard LED kepyad*
- *IN– optional LCD keypad*

See "Table Legend" on page 4–3 for details on each column in the table below.

INPUT Parameter Group (In, IN)								
Pr. Code	**Name**	**Setting Range**	**Initial Value**	**Run R/W**	**Parameter Dependency**	**Compatible Control Mode**	**Comm. Address (Hex)**	**Ref.**
In.0	Jump Code	1–99	65	♦R/W	–	v, s, i, p	–	3–5
In.1	Frequency for maximum analog input	Start frequency–Maximum frequency(Hz)	Maximum frequency	♦R/W	–	v, s, i, p	0h1501	4–69
In.2	Torque at maximum analog input	0.0–200.0%	100.0	♦R/W	–	i	0h1502	4–166
In.5	V1 input voltage display	–12.00–12.00V	0.00	Read Only	–	v, s, i, p	0h1505	4–69
In.6	V1 input polarity selection	0 Unipolar 1 Bipolar	0: Unipolar	R/W	–	v, s, i, p	0h1506	4–69
In.7	Time constant of V1 input filter	0–10000(ms)	10	♦R/W	–	v, s, i, p	0h1507	4–69
In.8	V1 Minimum input voltage	0.00–10.00V	0.00	♦R/W	–	v, s, i, p	0h1508	4–69
In.9	V1 output at Minimum voltage (%)	0.00–100.00%	0.00	♦R/W	–	v, s, i, p	0h1509	4–69
In.10	V1 Maximum input voltage	0.00–12.00V	10.00	♦R/W	–	v, s, i, p	0h150A	4–69
In.11	V1 output at Maximum voltage (%)	0.00–100.00%	100.00	♦R/W	–	v, s, i, p	0h150B	4–69
In.12	V1 Minimum input voltage	–10.00– 0.00V	0.00	♦R/W	In.6=1	v, s, i, p	0h150C	4–72
In.13	V1output at Minimum voltage (%)	–100.00–0.00%	0.00	♦R/W	In.6=1	v, s, i, p	0h150D	4–72
In.14	V1 Maximum input voltage	–12.00– 0.00V	–10.00	♦R/W	In.6=1	v, s, i, p	0h150E	4–72
In.15	V1 output at Maximum voltage (%)	–100.00–0.00%	–100.00	♦R/W	In.6=1	v, s, i, p	0h150F	4–72
In.16	V1 rotation direction change	0 No 1 Yes	0: No	♦R/W	–	v, s, i, p	0h1510	4–69
In.17	V1 quantization level	0.00, 0.04–10.00%	0.04	R/W	–	v, s, i, p	0h1511	4–69
In.35	V2 input voltage display	0.00–12.00V	0.00	Read Only	Analog Input Dipswitch =V	v, s, i, p	0h1523	4–74
In.37	V2 input filter time constant	0–10000(ms)	10	♦R/W	Analog Input Dipswitch =V	v, s, i, p	0h1525	4–74
In.38	V2 Minimum input voltage	0.00–10.00V	0.00	♦R/W	Analog Input Dipswitch =V	i, p	0h1526	4–74

INPUT Parameter Group (In, IN)									
Pr. Code	Name	Setting Range		Initial Value	Run R/W	Parameter Dependency	Compatible Control Mode	Comm. Address (Hex)	Ref.
In.39	V2 output at Minimum voltage (%)	0.00–100.00%		0.00	♦R/W	Analog Input Dipswitch =V	v, s, i, p	0h1527	4–74
In.40	V2 Maximum input voltage	0.00–10.00V		10	♦R/W	Analog Input Dipswitch =V	i, p	0h1528	4–74
In.41	V2 output at Maximum voltage (%)	0.00–100.00%		100.00	♦R/W	Analog Input Dipswitch =V	v, s, i, p	0h1529	4–74
In.46	V2 rotation direction change	0	No	0: No	♦R/W	Analog Input Dipswitch =V	v, s, i, p	0h152E	4–74
		1	Yes						
In.47	V2 quantization level	0.0045, 0.04– 10.00%		0.04	♦R/W	Analog Input Dipswitch =V	v, s, i, p	0h152F	4–74
In.50	I2 input current display	0–24 mA		0.00	Read Only	Analog Input Dipswitch =I	v, s, i, p	0h1532	4–73
In.52	I2 input filter time constant	0–10000ms		100	♦R/W	Analog Input Dipswitch =I	v, s, i, p	0h1534	4–73
In.53	I2 minimum input current	0.00–20.00 mA		4.00	♦R/W	Analog Input Dipswitch =I	v, s, i, p	0h1535	4–73
In.54	I2 output at Minimum current (%)	0.00–100.00%		0.00	♦R/W	Analog Input Dipswitch =I	v, s, i, p	0h1536	4–73
In.55	I2 maximum input current	0.00–24.00mA		20.00	♦R/W	Analog Input Dipswitch =I	v, s, i, p	0h1537	4–73
In.56	I2 output at Maximum current (%)	0.00–100.00%		100.00	♦R/W	Analog Input Dipswitch =I	v, s, i, p	0h1538	4–73
In.61	Changing rotation direction of I2	0	No	0: No	♦R/W	Analog Input Dipswitch =I	v, s, i, p	0h153D	4–73
		1	Yes						
In.62	I2 quantization level	0.0045, 0.04–10.00%		0.04	♦R/W	Analog Input Dipswitch =I	v, s, i, p	0h153E	4–73

INPUT Parameter Group (In, IN)									
Pr. Code	Name	Setting Range		Initial Value	Run R/W	Parameter Dependency	Compatible Control Mode	Comm. Address (Hex)	Ref.
In.65	P1 terminal function setting	0	None	1: Fx	R/W	–	v, s, i, p	0h1541	
		1	Fx						4–79
		2	Rx						
		3	RST						4–210
		4	External Trip						4–205
		5	BX						4–210
		6	JOG						4–129
		7	Speed–L						4–77
		8	Speed–M						
		9	Speed–H						
		11	XCEL–L						4–88
		12	XCEL–M						
		13	RUN Enable						4–135
		14	3–Wire						4–134
		15	2nd Source						4–104
		16	Exchange						4–175
		17	Up (Speed)						4–132
		18	Down (Speed)						
		20	U/D Clear						
		21	Analog Hold						4–76
		22	I–Term Clear						4–140
		23	PID Openloop						
		24	P Gain2						
		25	XCEL Stop						4–93
		26	2nd Motor						4–174
		34	Pre Excite						4–93
		38	Timer In						4–183
		40	dis Aux Ref						4–126
		46	FWD JOG						4–131
		47	REV JOG						4–131
		49	XCEL–H						4–88
		50	User Seq						4–108
		51	Fire Mode						4–123
		52	KEB–1 Select						4–162
		54	TI (In.69 Only)						
In.66	P2 terminal function setting	See In.65 for Setting Range		2: Rx	R/W	–	v, s, i, p	0h1542	See In.65
In.67	P3 terminal function setting	See In.65 for Setting Range		5: BX	R/W	–	v, s, i, p	0h1543	See In.65
In.68	P4 terminal function setting	See In.65 for Setting Range		3: RST	R/W	–	v, s, i, p	0h1544	See In.65
In.69	P5 terminal function setting	See In.65 for Setting Range		7: Speed–L	R/W	–	v, s, i, p	0h1545	See In.65

INPUT Parameter Group (In, IN)								
Pr. Code	**Name**	**Setting Range**	**Initial Value**	**Run R/W**	**Parameter Dependency**	**Compatible Control Mode**	**Comm. Address (Hex)**	**Ref.**
In.72	P8 terminal function setting (Ext IO)	See In.65 for Setting Range	0: None				0h1548	
In.73	P9 terminal function setting (Ext IO)	See In.65 for Setting Range	0: None				0h1549	
In.74	P10 terminal function setting (Ext IO)	See In.65 for Setting Range	0: None				0h154A	
In.84	Multi–function input terminal On filter selection	Bit Value: 0 Disable 1 Enable Bit Assignment: 0 P1 1 P2 2 P3 3 P4 4 P5 8 P8 (Ext IO card) 9 P9 (Ext IO card) 10 P10 (Ext IO card)	1 1111	♦R/W	–	v, s, i, p	0h1554	4–105
In.85	Multi–function input terminal On filter	0–10000(ms)	10	♦R/W	–	v, s, i, p	0h1555	4–105
In.86	Multi–function input terminal Off filter	0–10000(ms)	3	♦R/W	–	v, s, i, p	0h1556	4–105
In.87	Multi–function input contact selection	Bit Value: 0 Norm Open(A) 1 Norm Closed(B) Bit Assignment: 0 P1 1 P2 2 P3 3 P4 4 P5 8 P8 (Ext IO card) 9 P9 (Ext IO card) 10 P10 (Ext IO card)	0 0000	R/W	–	v, s, i, p	0h1557	4–105
In.89	Multi–step command delay time	1–5000(ms)	1	R/W	–	v, s, i, p	0h1559	4–77

INPUT Parameter Group (In, IN)								
Pr. Code	**Name**	**Setting Range**	**Initial Value**	**Run R/W**	**Parameter Dependency**	**Compatible Control Mode**	**Comm. Address (Hex)**	**Ref.**
In.90	Multi–function input terminal status	Bit Value: 0 Off 1 On Bit Assignment: 0 P1 1 P2 2 P3 3 P4 4 P5 8 P8 (Ext IO card) 9 P9 (Ext IO card) 10 P10 (Ext IO card)	0 0000	Read Only	–	v, s, i, p	0h155A	4–105
In.91	Pulse input amount display	0.00–50.00kHz	0.00	Read Only	–	v, s, i, p	0h155B	4–75
In.92	TI input filter time constant	0–9999(ms)	10	♦R/W	–	v, s, i, p	0h155C	4–75
In.93	TI Minimum input pulse	0.00–32.00kHz	0.00	♦R/W	–	v, s, i, p	0h155D	4–75
In.94	TI output at Minimum pulse (%)	0.00–100.00%	0.00	♦R/W	–	v, s, i, p	0h155E	4–75
In.95	TI Maximum input pulse	0.00–32.00kHz	32.00	♦R/W	–	v, s, i, p	0h155F	4–75
In.96	TI Output at Maximum pulse (%)	0–100%	100.00	♦R/W	–	v, s, i, p	0h1560	4–75
In.97	TI rotation direction change	0 No 1 Yes	0: No	♦R/W	–	v, s, i, p	0h1561	4–75
In.98	TI quantization level	0.0045, 0.04–10.00%	0.04	♦R/W	–	v, s, i, p	0h1562	4–75
In.99	"SW1(NPN/PNP) SW2(V1/V2) status"	Bit 00–11 00 V2, NPN 01 V2, PNP 10 I2, NPN 11 I2, PNP	00	Read Only	–	v, s, i, p	0h1563	–

OUTPUT Parameter Group (OU, OUT)

The OUTPUT parameter group is labeled as follows:

- *OU – standard LED kepyad*
- *OUT– optional LCD keypad*

See "Table Legend" on page 4–3 for details on each column in the table below.

OUTPUT Parameter Group (OU, OUT)									
Pr. Code	**Name**	**Setting Range**		**Initial Value**	**Run R/W**	**Parameter Dependency**	**Compatible Control Mode**	**Comm. Address (Hex)**	**Ref.**
OU.0	Jump Code	1–99		30	♦R/W	–	v, s, i, p	–	3–5
OU.1	Analog output 1 Mode	0	Frequency	0: Frequency	♦R/W	–	v, s, i, p	0h1601	4–186
		1	Output Current						
		2	Output Voltage						
		3	DCLink Voltage						
		4	Torque						
		5	Output Power						
		6	Idse						
		7	Iqse						
		8	Target Freq						
		9	Ramp Freq						
		10	Speed Fdb						
		12	PID Ref Value						
		13	PID Fdb Value						
		14	PID Output						
		15	Constant						
OU.2	Analog output 1 gain	–1000.0–1000.0%		100.0	♦R/W	–	v, s, i, p	0h1602	4–186
OU.3	Analog output 1 bias	–100.0–100.0%		0.0	♦R/W	–	v, s, i, p	0h1603	4–186
OU.4	Analog output 1 filter	0–10000(ms)		5	♦R/W	–	v, s, i, p	0h1604	4–186
OU.5	Analog constant output 1	0.0–100.0%		0.0	♦R/W	–	v, s, i, p	0h1605	4–186
OU.6	Analog output 1 monitor	0.0–1000.0%		0.0	Read Only	–	v, s, i, p	0h1606	4–186
OU.30	Fault output item	bit	000–111	010	♦R/W	–	v, s, i, p	0h161E	4–193
		001	Low voltage						
		010	Any faults other than low voltage						
		100	Automatic restart final failure						

OUTPUT Parameter Group (OU, OUT)									
Pr. Code	Name	Setting Range		Initial Value	Run R/W	Parameter Dependency	Compatible Control Mode	Comm. Address (Hex)	Ref.
OU.31	Multi–function Output Relay 1 Setting (A1, B1, C1 terminals)	0	None	29: Trip	♦R/W	–	v, s, i, p	0h161F	4–190
		1	FDT–1						
		2	FDT–2						
		3	FDT–3						
		4	FDT–4						
		5	Over Load						
		6	IOL						
		7	Under Load						
		8	Fan Warning						
		9	Stall						
		10	Over Voltage						
		11	Low Voltage						
		12	Over Heat						
		13	Lost Command						
		14	Run						
		15	Stop						
		16	Steady						
		17	Drive Line						
		18	Comm Line						
		19	Speed Search						
		22	Ready						
		28	Timer Out						
		29	Trip						
		31	DB Warn%ED						
		34	On/Off Control						
		35	BR Control						
		38	Fire Mode						
		39*	TO (OU.33 Only)						
		40	KEB Operating						
OU.33	Multi–function output Q1 setting	See OU.31 values		14: Run	♦R/W	–	v, s, i, p	0h1621	4–190
OU.34	Multi–function relay 3 setting	See OU.31 values		0: None	♦R/W		v, s, i, p	0h1622	4–190
OU.35	Multi–function relay 4 setting	See OU.31 values		0: None	♦R/W		v, s, i, p	0h1623	4–190
OU.41	Multi–function output monitor	Bit	00 0000 – 11 1111	00	Read Only	–	–	0h1629	4–190
		0	Relay 1						
		1	Q1						
		4	Relay 3 (Ext IO card)						
		5	Relay 4 (Ext IO card)						
OU.50	Multi–function output On delay	0.00–100.00s		0.00	♦R/W	–	v, s, i, p	0h1632	4–194
OU.51	Multi–function output Off delay	0.00–100.00s		0.00	♦R/W	–	v, s, i, p	0h1633	4–194

OUTPUT Parameter Group (OU, OUT)								
Pr. Code	**Name**	**Setting Range**	**Initial Value**	**Run R/W**	**Parameter Dependency**	**Compatible Control Mode**	**Comm. Address (Hex)**	**Ref.**
OU.52	Multi–function output contact selection	Bit Value: 0 = A Contact (NO) 1 = B Contact (NC) Bit: 00 0000 – 11 1111 0 Relay 1 1 Q1 4 Relay 3 (Ext IO) 5 Relay 4 (Ext IO)	00	R/W	–	v, s, i, p	0h1634	4–194
OU.53	Fault output On delay	0.00–100.00s	0.00	♦R/W	–	v, s, i, p	0h1635	4–193
OU.54	Fault output Off delay	0.00–100.00s	0.00	♦R/W	–	v, s, i, p	0h1636	4–193
OU.55	Timer On delay	0.00–100.00s	0.00	♦R/W	–	v, s, i, p	0h1637	4–183
OU.56	Timer Off delay	0.00–100.00s	0.00	♦R/W	–	v, s, i, p	0h1638	4–183
OU.57	Detected frequency	0.00–Maximum frequency(Hz)	30.00	♦R/W	–	v, s, i, p	0h1639	4–190
OU.58	Detected frequency band	0.00–Maximum frequency(Hz)	10.00	♦R/W	–	v, s, i, p	0h163A	4–190
OU.61	TO/Q1 Pulse output gain	0 Frequency 1 Output Current 2 Output Voltage 3 DCLink Voltage 4 Torque 5 Output Power 6 Idse 7 Iqse 8 Target Freq 9 Ramp Freq 10 Speed Fdb 12 PID Ref Value 13 PID Fdb Value 14 PID Output 15 Constant	0: Frequency	♦R/W	–	v, s, i, p	0h163D	4–188
OU.62	Pulse output gain	–1000.0–1000.0%	100.0	♦R/W	–	v, s, i, p	0h163E	4–188
OU.63	Pulse output bias	–100.0–100.0%	0.0	♦R/W	–	v, s, i, p	0h163F	4–188
OU.64	Pulse output filter	0–10000(ms)	5	♦R/W	–	v, s, i, p	0h1640	4–188
OU.65	Pulse output constant output 2	0.0–100.0%	0.0	♦R/W	–	v, s, i, p	0h1641	4–188
OU.66	Pulse output monitor	0.0–1000.0%	0.0	Read Only	–	v, s, i, p	0h1642	4–188

COMMUNICATION Parameter Group (Cm, COM)

The COMMUNICATION parameter group is labeled as follows:

- *Cm – standard LED kepyad*
- *COM– optional LCD keypad*

See "Table Legend" on page 4–3 for details on each column in the table below.

COMMUNICATION Parameter Group (Cm, COM)									
Pr. Code	**Name**	**Setting Range**		**Initial Value**	**Run R/W**	**Parameter Dependency**	**Compatible Control Mode**	**Comm. Address (Hex)**	**Ref.**
CM.0	Jump Code	1–99		20	♦R/W	–	v, s, i, p	–	3–5
CM.1	Built–in communication drive ID	1–250		1	♦R/W	CM.95=0 or 3	v, s, i, p	0h1701	5–7
CM.2	Built–in communication protocol	0	ModBus RTU	0: ModBus RTU	♦R/W	CM.95=0 or 3	v, s, i, p	0h1702	5–7
		2	Not Supported						
CM.3	Built–in communication speed	0	1200 bps	3: 9600 bps	♦R/W	CM.95=0 or 3	v, s, i, p	0h1703	5–7
		1	2400 bps						
		2	4800 bps						
		3	9600 bps						
		4	19200 bps						
		5	38400 bps						
		6	56 Kbps						
		7	115 Kbps						
CM.4	Built–in communication frame setting	0	D8/PN/S1	0: D8/PN/S1	♦R/W	CM.95=0 or 3	v, s, i, p	0h1704	5–7
		1	D8/PN/S2						
		2	D8/PE/S1						
		3	D8/PO/S1						
CM.5	Transmission delay after reception	0–1000(ms)		5ms	♦R/W	CM.95=0 or 3	v, s, i, p	0h1705	5–7
CM.6	Ethernet Module (Fbus) S/W version	–		0.00	♦R/W	ACN–ETH Installed	v, s, i, p	0h1706	–
CM.9	Ethernet Module (Fbus) LED status	–		–	Read Only	ACN–ETH Installed	v, s, i, p	0h1709	–
CM.10	Opt Parameter 1 (IP address 1st octet)	0–255		192	R/W	ACN–ETH Installed	v, s, i, p	0h170A	–
CM.11	Opt Parameter 2 (IP address 2nd octet)	0–255		192	R/W	ACN–ETH Installed	v, s, i, p	0h170B	–
CM.12	Opt Parameter 3 (IP address 3rd octet)	0–255		168	R/W	ACN–ETH Installed	v, s, i, p	0h170C	–
CM.13	Opt Parameter 4 (IP address 4th octet)	0–255		3	R/W	ACN–ETH Installed	v, s, i, p	0h170D	–

**CM.29 and CM.49 must be configured to the same value for proper EtherNet/IP communication.*
***If ACN-ETH card is used in EtherNet/IP mode, value is read-only and set according to the CM.29 or CM.49 value.*

COMMUNICATION Parameter Group (Cm, COM)									
Pr. Code	Name	Setting Range		Initial Value	Run R/W	Parameter Dependency	Compatible Control Mode	Comm. Address (Hex)	Ref.
CM.14	Opt Parameter 5 (IP Mask 1st octet)	0–255		255	R/W	ACN–ETH Installed	v, s, i, p	0h170E	–
CM.15	Opt Parameter 6 (IP Mask 2nd octet)	0–255		255	R/W	ACN–ETH Installed	v, s, i, p	0h170F	–
CM.16	Opt Parameter 7 (IP Mask 3rd octet)	0–255		255	R/W	ACN–ETH Installed	v, s, i, p	0h1710	–
CM.17	Opt Parameter 8 (IP Mask 4th octet)	0–255		0	R/W	ACN–ETH Installed	v, s, i, p	0h1711	–
CM.18	Opt Parameter 9 (IP Gateway 1st octet)	0–255		255	R/W	ACN–ETH Installed	v, s, i, p	0h1712	–
CM.19	Opt Parameter 10 (IP Gateway 2nd octet)	0–255		255	R/W	ACN–ETH Installed	v, s, i, p	0h1713	–
CM.20	Opt Parameter 11 (IP Gateway 3rd octet)	0–255		255	R/W	ACN–ETH Installed	v, s, i, p	0h1714	–
CM.21	Opt Parameter 12 (IP Gateway 4th octet)	0–255		1	R/W	ACN–ETH Installed	v, s, i, p	0h1715	–
CM.22	OptParameter13 – Eth Comm Rate	0	Automatic	0	R/W	ACN–ETH Installed	v, s, i, p	0h1716	–
		1	100 MB						
		2	10 MB						
CM.29*	In Instance	0	70	0: 70	R/W	ACN–ETH Installed	v, s, i, p (EtherNet/IP Only)	0h171D	–
		1	71						
		2	110						
		3	111						
		4	141						
		5	142						
		6	143						
		7	144						
		8	145						
		9	146						
		10	147						
		11	148						
CM.30	Number of output parameters	0–8		3	R/W**	–	v, s, i, p	0h171E	–
CM.31	Output Communication Address–1	0000–FFFF Hex		000A	♦R/W	–	v, s, i, p	0h171F	5–12

**CM.29 and CM.49 must be configured to the same value for proper EtherNet/IP communication.*
***If ACN-ETH card is used in EtherNet/IP mode, value is read-only and set according to the CM.29 or CM.49 value.*

COMMUNICATION Parameter Group (Cm, COM)								
Pr. Code	Name	Setting Range	Initial Value	Run R/W	Parameter Dependency	Compatible Control Mode	Comm. Address (Hex)	Ref.
CM.32	Output Communication Address–2	0000–FFFF Hex	000E	♦R/W	–	v, s, i, p	0h1720	5–12
CM.33	Output Communication Address–3	0000–FFFF Hex	000F	♦R/W	–	v, s, i, p	0h1721	5–12
CM.34	Output Communication Address–4	0000–FFFF Hex	0000	♦R/W	–	v, s, i, p	0h1722	5–12
CM.35	Output Communication Address–5	0000–FFFF Hex	0000	♦R/W	–	v, s, i, p	0h1723	5–12
CM.36	Output Communication Address–6	0000–FFFF Hex	0000	♦R/W	–	v, s, i, p	0h1724	5–12
CM.37	Output Communication Address–7	0000–FFFF Hex	0000	♦R/W	–	v, s, i, p	0h1725	5–12
CM.38	Output Communication Address–8	0000–FFFF Hex	0000	♦R/W	–	v, s, i, p	0h1726	5–12
CM.49*	Out Instance	0: 20 1: 21 2: 100 3: 101 4: 121 5: 122 6: 123 7: 124 8: 125 9: 126 10: 127 11: 128	0: 20	–	ACN–ETH Installed	v, s, i, p (EtherNet/IP Only)	0h1731	5–12
CM.50	Number of input parameters	0–8	2	R/W**	–	v, s, i, p	0h1732	–
CM.51	Input Communication address1	0000–FFFF Hex	0005	R/W	–	v, s, i, p	0h1733	5–12
CM.52	Input Communication address2	0000–FFFF Hex	0006	R/W	–	v, s, i, p	0h1734	5–12
CM.53	Input Communication address3	0000–FFFF Hex	0000	R/W	–	v, s, i, p	0h1735	5–12
CM.54	Input Communication address4	0000–FFFF Hex	0000	R/W	–	v, s, i, p	0h1736	5–12

**CM.29 and CM.49 must be configured to the same value for proper EtherNet/IP communication.*
***If ACN-ETH card is used in EtherNet/IP mode, value is read-only and set according to the CM.29 or CM.49 value.*

COMMUNICATION Parameter Group (Cm, COM)									
Pr. Code	Name	Setting Range		Initial Value	Run R/W	Parameter Dependency	Compatible Control Mode	Comm. Address (Hex)	Ref.
CM.55	Input Communication address5	0000–FFFF Hex		0000	R/W	–	v, s, i, p	0h1737	5–12
CM.56	Input Communication address6	0000–FFFF Hex		0000	R/W	–	v, s, i, p	0h1738	5–12
CM.57	Input Communication address7	0000–FFFF Hex		0000	R/W	–	v, s, i, p	0h1739	5–12
CM.58	Input Communication address8	0000–FFFF Hex		0000	R/W	–	v, s, i, p	0h173A	5–12
CM.68	Field bus data swap	0	No	0	R/W	–	v, s, i, p	0h1744	5–12
		1	Not Supported						

**CM.29 and CM.49 must be configured to the same value for proper EtherNet/IP communication.*
***If ACN-ETH card is used in EtherNet/IP mode, value is read-only and set according to the CM.29 or CM.49 value.*

COMMUNICATION Parameter Group (Cm, COM)									
Pr. Code	Name	Setting Range		Initial Value	Run R/W	Parameter Dependency	Compatible Control Mode	Comm. Address (Hex)	Ref.
CM.70	Communication multi–function virtual input 1	0	None	0: None	♦R/W	–	v, s, i, p	0h1746	–
		1	Fx						
		2	Rx						
		3	RST						
		4	External Trip						
		5	BX						
		6	JOG						
		7	Speed–L						
		8	Speed–M						
		9	Speed–H						
		11	XCEL–L						
		12	XCEL–M						
		13	RUN Enable						
		14	3–Wire						
		15	2nd Source						
		16	Exchange						
		17	Up						
		18	Down						
		20	U/D Clear						
		21	Analog Hold						
		22	I–Term Clear						
		23	PID Openloop						
		24	P Gain2						
		25	XCEL Stop						
		26	2nd Motor						
		34	Pre Excite						
		38	Timer In						
		40	dis Aux Ref						
		46	FWD JOG						
		47	REV JOG						
		49	XCEL–H						
		50	User Seq						
		51	Fire Mode						
		52	KEB–1 Select						
		54	TI						
CM.71	Communication multi–function virtual input 2	See CM.70 for Values		0: None	♦R/W	–	v, s, i, p	0h1747	–
CM.73	Communication multi–function virtual input 4	See CM.70 for Values		0: None	♦R/W	–	v, s, i, p	0h1749	–

**CM.29 and CM.49 must be configured to the same value for proper EtherNet/IP communication.*
***If ACN-ETH card is used in EtherNet/IP mode, value is read-only and set according to the CM.29 or CM.49 value.*

COMMUNICATION Parameter Group (Cm, COM)									
Pr. Code	Name	Setting Range		Initial Value	Run R/W	Parameter Dependency	Compatible Control Mode	Comm. Address (Hex)	Ref.
CM.74	Communication multi–function virtual input 5	See CM.70 for Values		0: None	♦R/W	–	v, s, i, p	0h174A	–
CM.75	Communication multi–function virtual input 6	See CM.70 for Values		0: None	♦R/W	–	v, s, i, p	0h174B	–
CM.76	Communication multi–function virtual input 7	See CM.70 for Values		0: None	♦R/W	–	v, s, i, p	0h174C	–
CM.77	Communication multi–function virtual input 8	See CM.70 for Values		0: None	♦R/W	–	v, s, i, p	0h174D	–
CM.86	Communication multi–function input monitoring	–		0	Read Only	–	v, s, i, p	0h1756	5–10
CM.90	Selection of data frame communication monitor	0	Int485	0	♦R/W	–	v, s, i, p	0h175A	–
		1	Keypad						
CM.91	Data frame Rev count	0–65535		0	♦R/W	–	v, s, i, p	0h175B	–
CM.92	Data frame Err count	0–65535		0	♦R/W	–	v, s, i, p	0h175C	–
CM.93	NAK frame count	0–65535		0	♦R/W	–	v, s, i, p	0h175D	–
CM.94	Communication data Save	0	No	0: No	Read Only	ACN–ETH Installed	v, s, i, p	–	5–9
		1	Yes						
CM.95	P2P communication selection	0	Disable All	0: Disable All	R/W	–	v, s, i, p	0h1760	4–106
		1	P2P Master						
		2	P2P Slave						
		3	M–KPD Ready						
CM.96	DO setting selection (P2P Out Select)	Bit	000–111 (See 4–3 for bit settings)	000: No	♦R/W	CM.95 = 2	v, s, i, p	–	4–106
		001	Analog output						
		010	Multi–function relay						
		100	Multi–function output						

**CM.29 and CM.49 must be configured to the same value for proper EtherNet/IP communication.*
***If ACN-ETH card is used in EtherNet/IP mode, value is read-only and set according to the CM.29 or CM.49 value.*

APPLICATION Parameter Group (AP , APP)

The APPLICATION parameter group is labeled as follows:

- *AP – standard LED kepyad*
- *APP– optional LCD keypad*

See "Table Legend" on page 4–3 for details on each column in the table below.

APPLICATION Parameter Group (AP , APP)									
Pr. Code	**Name**	**Setting Range**		**Initial Value**	**Run R/W**	**Parameter Dependency**	**Compatible Control Mode**	**Comm. Address (Hex)**	**Ref.**
AP.0	Jump Code	1–99		20	♦R/W	–	v, s, i, p	–	3–5
AP.1	Application function selection	0	None	0: None	R/W	–	v, s, i, p	0h1801	4–140
		1	–						
		2	Proc PID						
AP.2	Enable user sequence	0	No	0: No	R/W	–	v, s, i, p	–	4–108
		1	Yes						
AP.16	PID output monitor	(%)		0.00	Read Only	AP.1 = 2	v, s, i, p	0h1810	4–140
AP.17	PID reference monitor	(%)		50.00	Read Only	AP.1 = 2	v, s, i, p	0h1811	4–140
AP.18	PID feedback monitor	(%)		0.00	Read Only	AP.1 = 2	v, s, i, p	0h1812	4–140
AP.19	PID reference setting	–100.00–100.00%		50.00	♦R/W	AP.1 = 2	v, s, i, p	0h1813	4–140
AP.20	PID reference source	0	Keypad	0: Keypad	R/W	AP.1 = 2	v, s, i, p	0h1814	4–140
		1	V1						
		3	V2						
		4	I2						
		5	Int 485						
		7	FieldBus (Ethernet)						
		8	UserSeqLink						
		11	Pulse						
		12	V3						
		14	V4						
		15	I4						
AP.21	PID feedback source	0	V1	0: V1	R/W	AP.1 = 2	v, s, i, p	0h1815	4–140
		2	V2						
		3	I2						
		4	Int 485						
		6	FieldBus (Ethernet)						
		7	UserSeqLink						
		10	Pulse						
		11	V3						
		13	V4						
		14	I4						
AP.22	PID controller proportional gain	0.0–1000.0%		50.0	♦R/W	AP.1 = 2	v, s, i, p	0h1816	4–140

APPLICATION Parameter Group (AP , APP)									
Pr. Code	Name	Setting Range		Initial Value	Run R/W	Parameter Dependency	Compatible Control Mode	Comm. Address (Hex)	Ref.
AP.23	PID controller integral time	0.0–200.0s		10.0	♦R/W	AP.1 = 2	v, s, i, p	0h1817	4–140
AP.24	PID controller differentiation time	0–1000(ms)		0	♦R/W	AP.1 = 2	v, s, i, p	0h1818	4–140
AP.25	PID controller feed–forward compensation gain	0.0–1000.0%		0.0	♦R/W	AP.1 = 2	v, s, i, p	0h1819	4–140
AP.26	Proportional gain scale	0.0–100.0%		100.0	R/W	AP.1 = 2	v, s, i, p	0h181A	4–140
AP.27	PID output filter	0–10000(ms)		0	♦R/W	AP.1 = 2	v, s, i, p	0h181B	4–140
AP.28	PID Mode	0	Process PID	0	R/W	AP.1 = 2	v, s, i, p	0h181C	4–140
		1	Normal PID						
AP.29	PID upper limit frequency	PID lower limit frequency–300.00Hz		60.00	♦R/W	AP.1 = 2	v, s, i, p	0h181D	4–140
AP.30	PID lower limit frequency	–300.00 –PID upper limit frequency(Hz)		–60.00	♦R/W	AP.1 = 2	v, s, i, p	0h181E	4–140
AP.31	PID output inverse	0	No	0: No	R/W	AP.1 = 2	v, s, i, p	0h181F	4–140
		1	Yes						
AP.32	PID output scale	0.1–1000.0%		100.0	R/W	AP.1 = 2	v, s, i, p	0h1820	4–140
AP.34	PID controller motion frequency	0.00–Maximum frequency(Hz)		0.00	R/W	AP.1 = 2	v, s, i, p	0h1822	4–140
AP.35	PID controller motion level	0.0–100.0%		0.0	R/W	AP.1 = 2	v, s, i, p	0h1823	4–140
AP.36	PID controller motion delay time	0–9999s		600	♦R/W	AP.1 = 2	v, s, i, p	0h1824	4–140
AP.37	PID sleep mode delay time	0.0–999.9s		60.0	♦R/W	AP.1 = 2	v, s, i, p	0h1825	4–140
AP.38	PID sleep mode frequency	0.00–Maximum frequency(Hz)		0.00	♦R/W	AP.1 = 2	v, s, i, p	0h1826	4–140
AP.39	PID wake–up level	0–100%		35	♦R/W	AP.1 = 2	v, s, i, p	0h1827	4–140
AP.40	PID wake–up mode setting	0	Below Level	0: Below Level	♦R/W	AP.1 = 2	v, s, i, p	0h1828	4–140
		1	Above Level						
		2	Beyond Level						

APPLICATION Parameter Group (AP , APP)									
Pr. Code	Name	Setting Range		Initial Value	Run R/W	Parameter Dependency	Compatible Control Mode	Comm. Address (Hex)	Ref.
AP.42	PID controller unit selection	0	%	0:%	♦R/W	AP.1 = 2	v, s, i, p	0h182A	4–140
		1	Bar						
		2	mBar						
		3	Pa						
		4	kPa						
		5	Hz						
		6	rpm						
		7	V						
		8	I						
		9	kW						
		10	HP						
		11	°C						
		12	°F						
		13	CUST						
		14	PSI						
		15	inWC						
		16	gl/m						
AP.43	PID unit gain	0.00–300.00%		100.00	♦R/W	AP.1 = 2	v, s, i, p	0h182B	4–140
AP.44	PID unit scale	0	x100	2: x 1	♦R/W	AP.1 = 2	v, s, i, p	0h182C	4–140
		1	x10						
		2	x 1						
		3	x 0.1						
		4	x 0.01						
AP.45	PID 2nd proportional gain	0.0–1000.0%		100.0	R/W	AP.1 = 2	v, s, i, p	0h182D	4–140

Extension IO Parameter Group (AO , APO)

The Extension IO parameter group is labeled as follows:

- *AO – standard LED keypad*
- *APO– optional LCD keypad*

See "Table Legend" on page 4–3 for details on each column in the table below.

NOTE: The Extension IO parameter group is available only when the ACN-EIO module is installed.

Extension IO Parameter Group (AO , APO)									
Pr. Code	Name	Setting Range		Initial Value	Run R/W	Parameter Dependency	Compatible Control Mode	Comm. Address (Hex)	Ref.
AO.0	Jump Code	1–99		0	♦R/W	–	v, s, i, p	–	3–5
AO.1	V3 input voltage display	–12.00–12.00V		0.00	Read Only	–	v, s, i, p	0h1A01	–
AO.2	V3 input polarity selection	0	Unipolar	0: Unipolar	R/W	–	v, s, i, p	0h1A02	–
		1	Bipolar						
AO.3	Time constant of V3 input filter	0–10000(ms)		100	♦R/W	–	v, s, i, p	0h1A03	–
AO.4	V3 Minimum input voltage	0.00–10.00V		0.00	♦R/W	–	v, s, i, p	0h1A04	–
AO.5	V3 output at Minimum voltage (%)	0.00–100.00%		0.00	♦R/W	–	v, s, i, p	0h1A05	–
AO.6	V3 Maximum input voltage	0.00–12.00V		10.00	♦R/W	–	v, s, i, p	0h1A06	–
AO.7	V3 output at Maximum voltage (%)	0.00–100.00%		100.00	♦R/W	–	v, s, i, p	0h1A07	–
AO.8	V3 rotation direction change	0	No	0: No	♦R/W	–	v, s, i, p	0h1A08	–
		1	Yes						
AO.9	V3 quantization level	0.00 , 0.04–10.00%		0.04	R/W	–	v, s, i, p	0h1A09	–
AO.10	V3 Minimum input voltage	–10.00–0.00V		0.00	♦R/W	AO.2 = 1	v, s, i, p	0h1A0A	–
AO.11	V3 output at Minimum voltage (%)	–100.00–0.00%		0.00	♦R/W	AO.2 = 1	v, s, i, p	0h1A0B	–
AO.12	V3 Maximum input voltage	–12.00–0.00V		–10.00	♦R/W	AO.2 = 1	v, s, i, p	0h1A0C	–
AO.13	V3 output at Maximum voltage (%)	–100.00–0.00%		–100.00	♦R/W	AO.2 = 1	v, s, i, p	0h1A0D	–
AO.14	V4 input voltage display	0.00–12.00V		0.00	Read Only	SW2= V (I4 input)	v, s, i, p	0h1A0E	–
AO.15	Time constant of V4 input filter	0–10000(ms)		100	♦R/W	SW2= V (I4 input)	v, s, i, p	0h1A0F	–
AO.16	V4 Minimum input voltage	0.00–10.00V		0.00	♦R/W	SW2= V (I4 input)	–	0h1A10	–
AO.17	V4 output at Minimum voltage (%)	0.00–100.00%		0.00	♦R/W	SW2= V (I4 input)	v, s, i, p	0h1A11	–

Extension IO Parameter Group (AO , APO)									
Pr. Code	Name	Setting Range		Initial Value	Run R/W	Parameter Dependency	Compatible Control Mode	Comm. Address (Hex)	Ref.
AO.18	V4 Maximum input voltage	0.00–10.00V		10	♦R/W	SW2= V (I4 input)	–	0h1A12	–
AO.19	V4 output at Maximum voltage (%)	0.00–100.00%		100.00	♦R/W	SW2= V (I4 input)	v, s, i, p	0h1A13	–
AO.20	V4 rotation direction change	0	No	0: No	♦R/W	SW2= V (I4 input)	v, s, i, p	0h1A14	–
		1	Yes						
AO.21	V4 quantization level	0.0050, 0.04–10.00%		0.04	♦R/W	SW2= V (I4 input)	v, s, i, p	0h1A15	–
AO.22	I4 input current display	0–24mA		0.00	Read Only	SW2= i (I4 input)	v, s, i, p	0h1A16	–
AO.23	I4 input filter time constant	0–10000(ms)		100	♦R/W	SW2= i (I4 input)	v, s, i, p	0h1A17	–
AO.24	I4 minimum input current	0.00–20.00mA		4.00	♦R/W	SW2= i (I4 input)	v, s, i, p	0h1A18	–
AO.25	I4 output at Minimum current (%)	0.00–100.00%		0.00	♦R/W	SW2= i (I4 input)	v, s, i, p	0h1A19	–
AO.26	I4 maximum input current	0.00–24.00mA		20.00	♦R/W	SW2= i (I4 input)	v, s, i, p	0h1A1A	–
AO.27	I4 output at Maximum current (%)	0.00–100.00%		100.00	♦R/W	SW2= i (I4 input)	v, s, i, p	0h1A1B	–
AO.28	Changing rotation direction of I4	0	No	0: No	♦R/W	SW2= i (I4 input)	v, s, i, p	0h1A1C	–
		1	Yes						
AO.29	I4 quantization level	0.00* , 0.04–10.00%		0.04	♦R/W	SW2= i (I4 input)	v, s, i, p	0h1A1D	–
AO.30	Analog output 3 item	0	Frequency	0: Frequency	♦R/W	–	v, s, i, p	0h1A1E	–
		1	Output Current						
		2	Output Voltage						
		3	DCLink Voltage						
		4	Torque						
		5	Output Power						
		6	Idse						
		7	Idr.						
		8	Target Freq						
		9	Ramp Freq						
		10	Speed Fdb						
		12	PID Ref Value						
		13	PID Fdb Value						
		14	PID Output						
		15	Constant						
AO.31	Analog output 3 gain	–1000.0–1000.0%		100.0	♦R/W	–	v, s, i, p	0h1A1F	–
AO.32	Analog output 3 bias	–100.0–100.0%		0.0	♦R/W	–	v, s, i, p	0h1A20	–

Extension IO Parameter Group (AO , APO)									
Pr. Code	Name	Setting Range		Initial Value	Run R/W	Parameter Dependency	Compatible Control Mode	Comm. Address (Hex)	Ref.
AO.33	Analog output 3 filter	0–10000(ms)		5	♦R/W	–	v, s, i, p	0h1A21	–
AO.34	Analog constant output 3	0.0–100.0%		0.0	♦R/W	–	v, s, i, p	0h1A22	–
AO.35	Analog output 3 monitor	0.0–1000.0%		0.0	Read Only	–	v, s, i, p	0h1A23	–
AO.36	Ext IO Switch	00	NPN, V	01	Read Only	–	v, s, i, p	0h1A24	–
		01	NPN, I						
		10	PNP, V						
		11	PNP, I						
AO.37	Ext I/O SW Ver	–		1.00	Read Only	–	v, s, i, p	0h1A25	–

PROTECTION Parameter Group (Pr, PRT)

The PROTECTION parameter group is labeled as follows:

- *Pr – standard LED kepyad*
- *PRT– optional LCD keypad*

See "Table Legend" on page 4–3 for details on each column in the table below.

PROTECTION Parameter Group (Pr, PRT)									
Pr. Code	Name	Setting Range		Initial Value	Run R/W	Parameter Dependency	Compatible Control Mode	Comm. Address (Hex)	Ref.
Pr.0	Jump Code	1–99		40	♦R/W	–	v, s, i, p	–	3–5
Pr.4	Load level setting	1	Heavy Duty	1: Heavy Duty	Read Only	–	v, s, i, p	0h1B04	4–200
Pr.5	Input/output open–phase protection	bit	00–11	00	R/W	–	v, s, i, p	0h1B05	4–204
		01	Output open phase						
		10	Input open phase						
Pr.6	Input voltage range during open–phase	1–100V		15	R/W	–	v, s, i, p	0h1B06	4–204
Pr.7	Deceleration time at fault trip	0.0–600.0s		3.0	♦R/W	–	v, s, i, p	0h1B07	4–206
Pr.8	Selection of startup on trip reset	0	No	0: No	♦R/W	–	v, s, i, p	0h1B08	4–172
		1	Yes						
Pr.9	Number of automatic restarts	0–10		0	♦R/W	–	v, s, i, p	0h1B09	4–172
Pr.10	Automatic restart delay time	0.0–60.0s		1.0	♦R/W	Pr.9>0	v, s, i, p	0h1B0A	4–172
Pr.12	Motion at speed command loss	0	None	0: None	♦R/W	–	v, s, i, p	0h1B0C	4–206
		1	Free–Run						
		2	Dec						
		3	Hold Input						
		4	Hold Output						
		5	Lost Preset						
Pr.13	Time to decide speed command loss	0.1–120s		1.0	♦R/W	Pr.12>0	v, s, i, p	0h1B0D	4–206
Pr.14	Operation frequency at speed command loss	Start frequency– Maximum frequency(Hz)		0.00	♦R/W	Pr.12>0	v, s, i, p	0h1B0E	4–206
Pr.15	Analog input loss decision level	0	Half x1	0: Half x1	♦R/W	Pr.12>0	v, s, i, p	0h1B0F	4–206
		1	Below x1						
Pr.17	Overload warning selection	0	No	0: No	♦R/W	–	v, s, i, p	0h1B11	4–200
		1	Yes						
Pr.18	Overload alarm level	30–180%		150	♦R/W	–	v, s, i, p	0h1B12	4–200
Pr.19	Overload warning time	0.0–30.0s		10.0	♦R/W	–	v, s, i, p	0h1B13	4–200

PROTECTION Parameter Group (Pr, PRT)									
Pr. Code	Name	Setting Range		Initial Value	Run R/W	Parameter Dependency	Compatible Control Mode	Comm. Address (Hex)	Ref.
Pr.20	Motion at overload fault	0	None	1: Free–Run	♦R/W	–	v, s, i, p	0h1B14	4–200
		1	Free–Run						
		2	Dec						
Pr.21	Overload fault level	30–200%		180	♦R/W	–	v, s, i, p	0h1B15	4–200
Pr.22	Overload fault time	0.0–60.0s		60.0	♦R/W	–	v, s, i, p	0h1B16	4–200
Pr.25	Underload warning selection	0	No	0: No	♦R/W	–	v, s, i, p	0h1B19	4–209
		1	Yes						
Pr.26	Underload warning time	0.0–600.0s		10.0	♦R/W	–	v, s, i, p	0h1B1A	4–209
Pr.27	Underload fault selection	0	None	0: None	♦R/W	–	v, s, i, p	0h1B1B	4–209
		1	Free–Run						
		2	Dec						
Pr.28	Underload fault time	0.0–600.0s		30.0	♦R/W	–	v, s, i, p	0h1B1C	4–209
Pr.29	Underload lower limit level	10–30%		30	♦R/W	–	v, s, i, p	0h1B1D	4–209
Pr.30	Underload upper limit level	30–100%		30	♦R/W	–	v, s, i, p	0h1B1E	4–209
Pr.31	No motor motion at detection	0	None	0: None	♦R/W	–	v, s, i, p	0h1B1F	4–211
		1	Free–Run						
Pr.32	No motor detection current level	1–100%		5	♦R/W	–	v, s, i	0h1B20	4–211
Pr.33	No motor detection delay	0.1–10.0s		3.0	♦R/W	–	v, s, i	0h1B21	4–211
Pr.40	Electronic thermal fault selection	0	None	0: None	♦R/W	–	v, s, i, p	0h1B28	4–198
		1	Free–Run						
		2	Dec						
Pr.41	Motor cooling fan type	0	Self–cool	0: Self–cool	♦R/W	–	v, s, i, p	0h1B29	4–198
		1	Forced–cool						
Pr.42	Electronic thermal 1 minute rating	120–200%		150	♦R/W	–	v, s, i, p	0h1B2A	4–198
Pr.43	Electronic thermal continuous rating	50–150%		120	♦R/W	–	v, s, i, p	0h1B2B	4–198
Pr.45	BX trip mode	0	Free–Run	0	R/W	–	v, s, i, p	0h1B2D	–
		1	Dec						

PROTECTION Parameter Group (Pr, PRT)									
Pr. Code	Name	Setting Range		Initial Value	Run R/W	Parameter Dependency	Compatible Control Mode	Comm. Address (Hex)	Ref.
Pr.50	Stall prevention motion and flux braking	bit	00000–11111	0 0000	R/W	dr.9≠6	v, s	0h1B32	4–201
		00001	Accelerating (Mode 1)						
		10001	Accelerating (Mode 2)						
		00010	At constant speed (Mode 1)						
		10010	At constant speed (Mode 2)						
		00100 or 10100	At deceleration						
		01000 or 11000	FluxBraking						
Pr.51	Stall frequency1	Start frequency – Stall frequency2 (Hz)		60.00	♦R/W	dr.9≠6	v, s	0h1B33	4–201
Pr.52	Stall level1	30–250%		180	R/W	dr.9≠6	v, s	0h1B34	4–201
Pr.53	Stall frequency2	Stall frequency1 – Stall frequency3 (Hz)		60.00	♦R/W	dr.9≠6	v, s	0h1B35	4–201
Pr.54	Stall level2	30–250%		180	R/W	dr.9≠6	v, s	0h1B36	4–201
Pr.55	Stall frequency3	Stall frequency2 – Stall frequency4 (Hz)		60.00	♦R/W	dr.9≠6	v, s	0h1B37	4–201
Pr.56	Stall level3	30–250%		180	R/W	dr.9≠6	v, s	0h1B38	4–201
Pr.57	Stall frequency4	Stall frequency3 – Maximum frequency (Hz)		60.00	♦R/W	dr.9≠6	v, s	0h1B39	4–201
Pr.58	Stall level4	30–250%		180	R/W	dr.9≠6	v, s	0h1B3A	4–201
Pr.59	Flux braking gain	0 – 150%		0	♦R/W	–	v, s, i	0h1B3B	–
Pr.66	DB resistor warning level	0–30%		0	♦R/W	–	v, s, i, p	0h1B42	4–207
Pr.73	Speed deviation trip	0	No	0: No	♦R/W	–	v, s, i, p	0h1B49	–
		1	Yes						
Pr.74	Speed deviation band	1 – 20		5	♦R/W	Pr.73=1	v, s, i, p	0h1B4A	–
Pr.75	Speed deviation time	0 – 120		60	♦R/W	Pr.73=1	v, s, i, p	0h1B4B	–
Pr.79	Cooling fan fault selection	0	Trip	1: Warning	♦R/W	–	v, s, i, p	0h1B4F	4–209
		1	Warning						
Pr.80	Motion selection at option trip	0	None	1: Free–Run	♦R/W	–	v, s, i, p	0h1B50	4–210
		1	Free–Run						
		2	Dec						
Pr.81	Low voltage fault decision delay time	0.0–60.0s		0.0	R/W	–	v, s, i, p	0h1B51	

PROTECTION Parameter Group (Pr, PRT)									
Pr. Code	Name	Setting Range		Initial Value	Run R/W	Parameter Dependency	Compatible Control Mode	Comm. Address (Hex)	Ref.
Pr.82	Low Voltage2 Trip Selection	Bit	00–11	00	R/W	–	v, s, i, p	0h1B52	4–212
		00	No						
		01	LV2, no history						
		10	No						
		11	LV2, save history						
Pr.90	Warning information	–		–	Read Only	–	–	–	–
Pr.91	Fault history 1	–		–	Read Only	–	v, s, i, p	0h1B5B	4–213
Pr.92	Fault history 2	–		–	Read Only	–	v, s, i, p	0h1B5C	4–213
Pr.93	Fault history 3	–		–	Read Only	–	v, s	0h1B5D	4–213
Pr.94	Fault history 4	–		–	Read Only	–	v, s	0h1B5E	4–213
Pr.95	Fault history 5	–		–	Read Only	–	v, s	0h1B5F	4–213
Pr.96	Fault history deletion	0	No	0: No	♦R/W	–	v, s	0h1B60	4–213
		1	Yes						

2nd MOTOR Parameter Group (m2, M2)

The M2 parameter group is labeled as follows:

- *m2 – standard LED kepyad*
- *M2– optional LCD keypad*

See "Table Legend" on page 4–3 for details on each column in the table below.

NOTE: The 2nd Motor parameter group is only available when any one input configuration parameter (In.65 - In.69) is set to 26.

2nd MOTOR Parameter Group (m2, M2)									
Pr. Code	**Name**	**Setting Range**		**Initial Value**	**Run R/W**	**Parameter Dependency**	**Compatible Control Mode**	**Comm. Address (Hex)**	**Ref.**
m2.0	Jump Code	1–99		14	♦R/W	–	v, s, i	–	3–5
m2.4	Acceleration time	0.0–600.0s		20.0	♦R/W	–	v, s, i	0h1C04	4–174
m2.5	Deceleration time	0.0–600.0s		30.0	♦R/W	–	v, s, i	0h1C05	4–174
m2.6	Motor capacity	0	0.2 kW	–	R/W	–	v, s, i	0h1C06	4–174
		1	0.4 kW						
		2	0.75 kW						
		3	1.1 kW						
		4	1.5 kW						
		5	2.2 kW						
		6	3.0 kW						
		7	3.7 kW						
		8	4.0 kW						
		9	5.5 kW						
		10	7.5 kW						
		11	11.0 kW						
		12	15.0 kW						
		13	18.5 kW						
		14	22.0 kW						
		15	30.0 kW						
m2.7	Base frequency	30.00–400.00Hz		60.00	R/W	–	v, s, i	0h1C07	4–174
m2.8	Control mode	0	V/F	0: V/F	R/W	–	v, s, i	0h1C08	4–174
		2	Slip Compen						
		4	IM Sensorless						
		6	PM Sensorless (Not Supported)						
m2.10	Number of motor poles	2–48		Dependent on motor settings	R/W	–	v, s, i	0h1C0A	4–174
m2.11	Rated slip speed	0–3000(rpm)		Dependent on motor settings	R/W	–	v, s, i	0h1C0B	4–174
m2.12	Motor rated current	1.0–1000.0A		Dependent on motor settings	R/W	–	v, s, i	0h1C0C	4–174

2nd MOTOR Parameter Group (m2, M2)								
Pr. Code	Name	Setting Range	Initial Value	Run R/W	Parameter Dependency	Compatible Control Mode	Comm. Address (Hex)	Ref.
m2.13	Motor no–load current	0.5–1000.0A	Dependent on motor settings	R/W	–	v, s, i	0h1C0D	4–174
m2.14	Motor rated voltage	170–480V	Dependent on motor settings	R/W	–	v, s, i	0h1C0E	4–174
m2.15	Motor efficiency	64–100%	Dependent on motor settings	R/W	–	v, s, i	0h1C0F	4–174
m2.16	Load inertia rate	0–8	Dependent on motor settings	R/W	–	v, s, i	0h1C10	4–174
m2.17	Stator resistance	Dependent on motor settings	Dependent on motor settings	R/W	–	v, s, i	–	4–174
m2.18	Leakage inductance	–	Dependent on motor settings	R/W	–	v, s, i	–	4–174
m2.19	Stator inductance	–	Dependent on motor settings	R/W	–	v, s, i	–	4–174
m2.20	Rotor time constant	25–5000(ms)	Dependent on motor settings	R/W	M2.08=4 IM Sensorless	v, s, i	–	4–174
m2.25	V/F pattern	0 Linear 1 Square 2 User V/F	0: Linear	R/W	–	v, s, i	0h1C19	4–174
m2.26	Forward Torque boost	0.0–15.0%	2.0	R/W	–	v, s, i	0h1C1A	4–174
m2.27	Reverse Torque boost	0.0–15.0%	2.0	R/W	–	v, s, i	0h1C1B	4–174
m2.28	Stall prevention level	30–150%	150	R/W	–	v, s, i	0h1C1C	4–174
m2.29	Electronic thermal 1 minute rating	100–200%	150	R/W	–	v, s, i	0h1C1D	4–174
m2.30	Electronic thermal continuous rating	50–150%	100	R/W	–	v, s, i	0h1C1E	4–174
m2.40	Rotation count speed gain	0–6000.0%	100.0	♦R/W	–	v, s, i	0h1C28	–
m2.41	Rotation count speed scale	0 x 1 1 x 0.1 2 x 0.01 3 x 0.001 4 x 0.0001	0: x 1	♦R/W	–	v, s, i	0h1C29	–
m2.42	Rotation count speed unit	0 Rpm 1 mpm	0: rpm	♦R/W	–	v, s, i	0h1C2A	–

USER SEQUENCE Parameter Group (US, USS)

The USER SEQUENCE parameter group is labeled as follows:

- *US – standard LED keypad*
- *USS– optional LCD keypad*

See "Table Legend" on page 4–3 for details on each column in the table below.

NOTE: User Sequence parameter group is only available when AP.2=1 or Cm.95=1

USER SEQUENCE Parameter Group (US, USS)									
Pr. Code	**Name**	**Setting Range**		**Initial Value**	**Run R/W**	**Parameter Dependency**	**Compatible Control Mode**	**Comm. Address (Hex)**	**Ref.**
US.0	Jump code	1–99		31	♦R/W	–	v, s, i, p	–	3–5
US.1	User sequence operation command	0	Stop	0: Stop	R/W	–	v, s, i, p	0h1D01	4–108
		1	Run						
		2	Digital In Run						
US.2	User sequence operation loop time	0	0.01s	1: 0.02s	R/W	–	v, s, i, p	0h1D02	4–108
		1	0.02s						
		2	0.05s						
		3	0.1s						
		4	0.5s						
		5	1s						
US.11	Output address link1	0–0xFFFF		0	R/W	–	v, s, i, p	0h1D0B	4–108
US.12	Output address link2	0–0xFFFF		0	R/W	–	v, s, i, p	0h1D0C	4–108
US.13	Output address link3	0–0xFFFF		0	R/W	–	v, s, i, p	0h1D0D	4–108
US.14	Output address link4	0–0xFFFF		0	R/W	–	v, s, i, p	0h1D0E	4–108
US.15	Output address link5	0–0xFFFF		0	R/W	–	v, s, i, p	0h1D0F	4–108
US.16	Output address link6	0–0xFFFF		0	R/W	–	v, s, i, p	0h1D10	4–108
US.17	Output address link7	0–0xFFFF		0	R/W	–	v, s, i, p	0h1D11	4–108
US.18	Output address link8	0–0xFFFF		0	R/W	–	v, s, i, p	0h1D12	4–108
US.19	Output address link9	0–0xFFFF		0	R/W	–	v, s, i, p	0h1D13	4–108
US.20	Output address link10	0–0xFFFF		0	R/W	–	v, s, i, p	0h1D14	4–108
US.21	Output address link11	0–0xFFFF		0	R/W	–	v, s, i, p	0h1D15	4–108
US.22	Output address link12	0–0xFFFF		0	R/W	–	v, s, i, p	0h1D16	4–108
US.23	Output address link13	0–0xFFFF		0	R/W	–	v, s, i, p	0h1D17	4–108
US.24	Output address link14	0–0xFFFF		0	R/W	–	v, s, i, p	0h1D18	4–108

USER SEQUENCE Parameter Group (US, USS)								
Pr. Code	Name	Setting Range	Initial Value	Run R/W	Parameter Dependency	Compatible Control Mode	Comm. Address (Hex)	Ref.
US.25	Output address link15	0–0xFFFF	0	R/W	–	v, s, i, p	0h1D19	4–108
US.26	Output address link16	0–0xFFFF	0	R/W	–	v, s, i, p	0h1D1A	4–108
US.27	Output address link17	0–0xFFFF	0	R/W	–	v, s, i, p	0h1D1B	4–108
US.28	Output address link18	0–0xFFFF	0	R/W	–	v, s, i, p	0h1D1C	4–108
US.31	Void Constant setting1	–9999–9999	0	R/W	–	v, s, i, p	0h1D1F	4–108
US.32	Void Constant setting2	–9999–9999	0	R/W	–	v, s, i, p	0h1D20	4–108
US.33	Void Constant setting3	–9999–9999	0	R/W	–	v, s, i, p	0h1D21	4–108
US.34	Void Constant setting4	–9999–9999	0	R/W	–	v, s, i, p	0h1D22	4–108
US.35	Void Constant setting5	–9999–9999	0	R/W	–	v, s, i, p	0h1D23	4–108
US.36	Void Constant setting6	–9999–9999	0	R/W	–	v, s, i, p	0h1D24	4–108
US.37	Void Constant setting7	–9999–9999	0	R/W	–	v, s, i, p	0h1D25	4–108
US.38	Void Constant setting8	–9999–9999	0	R/W	–	v, s, i, p	0h1D26	4–108
US.39	Void Constant setting9	–9999–9999	0	R/W	–	v, s, i, p	0h1D27	4–108
US.40	Void Constant setting10	–9999–9999	0	R/W	–	v, s, i, p	0h1D28	4–108
US.41	Void Constant setting11	–9999–9999	0	R/W	–	v, s, i, p	0h1D29	4–108
US.42	Void Constant setting12	–9999–9999	0	R/W	–	v, s, i, p	0h1D2A	4–108
US.43	Void Constant setting13	–9999–9999	0	R/W	–	v, s, i, p	0h1D2B	4–108
US.44	Void Constant setting14	–9999–9999	0	R/W	–	v, s, i, p	0h1D2C	4–108
US.45	Void Constant setting15	–9999–9999	0	R/W	–	v, s, i, p	0h1D2D	4–108
US.46	Void Constant setting16	–9999–9999	0	R/W	–	v, s, i, p	0h1D2E	4–108
US.47	Void Constant setting17	–9999–9999	0	R/W	–	v, s, i, p	0h1D2F	4–108
US.48	Void Constant setting18	–9999–9999	0	R/W	–	v, s, i, p	0h1D30	4–108
US.49	Void Constant setting19	–9999–9999	0	R/W	–	v, s, i, p	0h1D31	4–108
US.50	Void Constant setting20	–9999–9999	0	R/W	–	v, s, i, p	0h1D32	4–108
US.51	Void Constant setting21	–9999–9999	0	R/W	–	v, s, i, p	0h1D33	4–108

USER SEQUENCE Parameter Group (US, USS)								
Pr. Code	Name	Setting Range	Initial Value	Run R/W	Parameter Dependency	Compatible Control Mode	Comm. Address (Hex)	Ref.
US.52	Void Constant setting22	–9999–9999	0	R/W	–	v, s, i, p	0h1D34	4–108
US.53	Void Constant setting23	–9999–9999	0	R/W	–	v, s, i, p	0h1D35	4–108
US.54	Void Constant setting24	–9999–9999	0	R/W	–	v, s, i, p	0h1D36	4–108
US.55	Void Constant setting25	–9999–9999	0	R/W	–	v, s, i, p	0h1D37	4–108
US.56	Void Constant setting26	–9999–9999	0	R/W	–	v, s, i, p	0h1D38	4–108
US.57	Void Constant setting27	–9999–9999	0	R/W	–	v, s, i, p	0h1D39	4–108
US.58	Void Constant setting28	–9999–9999	0	R/W	–	v, s, i, p	0h1D3A	4–108
US.59	Void Constant setting29	–9999–9999	0	R/W	–	v, s, i, p	0h1D3B	4–108
US.60	Void Constant setting30	–9999–9999	0	R/W	–	v, s, i, p	0h1D3C	4–108
US.80	Analog input 1	0–12, 000	–	Read Only	CM.95=1 P2P master	v, s, i, p	0h1D50	4–108
US.81	Analog input2	–12, 000–12, 000	–	Read Only	CM.95=1 P2P master	v, s, i, p	0h1D51	4–108
US.82	Digital input	0–0x7F	–	Read Only	CM.95=1 P2P master	v, s, i, p	0h1D52	4–108
US.85	Analog output	0–10, 000	0	R/W	CM.95=1 P2P master	v, s, i, p	0h1D55	4–108
US.89	Digital output	0–0x03	0	R/W	CM.95=1 P2P master	v, s, i, p	0h1D58	4–108

USER SEQUENCE FUNCTION Parameter Group (UF , USF)

The USER SEQUENCE FUNCTION parameter group is labeled as follows:

- *UF – standard LED kepyad*
- *USF– optional LCD keypad*

See "Table Legend" on page 4–3 for details on each column in the table below.

NOTE: User Sequence Function parameter group is only available when AP.2=1 or Cm.95=1

USER SEQUENCE FUNCTION Parameter Group (UF , USF)									
Pr. Code	**Name**	**Setting Range**		**Initial Value**	**Run R/W**	**Parameter Dependency**	**Compatible Control Mode**	**Comm. Address (Hex)**	**Ref.**
UF.0	Jump code	1–99		41	♦R/W	–	v, s, i, p	–	3–5
UF.1	User function1	0	NOP	0: NOP	R/W	–	v, s, i, p	0h1E01	4–108
		1	ADD						
		2	SUB						
		3	ADDSUB						
		4	MIN						
		5	MAX						
		6	ABS						
		7	NEGATE						
		8	MPYDIV						
		9	REMAINDER						
		10	COMPARE–GT						
		11	COMPARE–GEQ						
		12	COMPARE–EQUAL						
		13	COMPARE–NEQUAL						
		14	TIMER						
		15	LIMIT						
		16	AND						
		17	OR						
		18	XOR						
		19	ANDOR						
		20	SWITCH						
		21	BITTEST						
		22	BITSET						
		23	BITCLEAR						
		24	LOWPASSFILTER						
		25	PI_CONTORL						
		26	PI_PROCESS						
		27	UPCOUNT						
		28	DOWNCOUNT						
UF.2	User function input1–A	0–0xFFFF		0	R/W	–	v, s, i, p	0h1E02	4–108
UF.3	User function input1–B	0–0xFFFF		0	R/W	–	v, s, i, p	0h1E03	4–108

USER SEQUENCE FUNCTION Parameter Group (UF , USF)								
Pr. Code	Name	Setting Range	Initial Value	Run R/W	Parameter Dependency	Compatible Control Mode	Comm. Address (Hex)	Ref.
UF.4	User function input1–C	0–0xFFFF	0	R/W	–	v, s, i, p	0h1E04	4–108
UF.5	User function output1	–32767–32767	0	Read Only	–	v, s, i, p	0h1E05	4–108
UF.6	User function 2	See UF.1 for Values	0: NOP	R/W	–	v, s, i, p	0h1E06	4–108
UF.7	User function input2–A	0–0xFFFF	0	R/W	–	v, s, i, p	0h1E07	4–108
UF.8	User function input2–B	0–0xFFFF	0	R/W	–	v, s, i, p	0h1E08	4–108
UF.9	User function input2–C	0–0xFFFF	0	R/W	–	v, s, i, p	0h1E09	4–108
UF.10	User function output2	–32767–32767	0	Read Only	–	v, s, i, p	0h1E0A	4–108
UF.11	User function3	See UF.1 for Values	0: NOP	R/W	–	v, s, i, p	0h1E0B	4–108
UF.12	User function input3–A	0–0xFFFF	0	R/W	–	v, s, i, p	0h1E0C	4–108
UF.13	User function input3–B	0–0xFFFF	0	R/W	–	v, s, i, p	0h1E0D	4–108
UF.14	User function input3–C	0–0xFFFF	0	R/W	–	v, s, i, p	0h1E0E	4–108
UF.15	User function output3	–32767–32767	0	Read Only	–	v, s, i, p	0h1E0F	4–108
UF.16	User function4	See UF.1 for Values	0: NOP	R/W	–	v, s, i, p	0h1E10	4–108
UF.17	User function input4–A	0–0xFFFF	0	R/W	–	v, s, i, p	0h1E11	4–108
UF.18	User function input4–B	0–0xFFFF	0	R/W	–	v, s, i, p	0h1E12	4–108
UF.19	User function input4–C	0–0xFFFF	0	R/W	–	v, s, i, p	0h1E13	4–108
UF.20	User function output4	–32767–32767	0	Read Only	–	v, s, i, p	0h1E14	4–108
UF.21	User function5	See UF.1 for Values	0: NOP	R/W	–	v, s, i, p	0h1E15	4–108
UF.22	User function input5–A	0–0xFFFF	0	R/W	–	v, s, i, p	0h1E16	4–108
UF.23	User function input5–B	0–0xFFFF	0	R/W	–	v, s, i, p	0h1E17	4–108
UF.24	User function input5–C	0–0xFFFF	0	R/W	–	v, s, i, p	0h1E18	4–108
UF.25	User function output5	–32767–32767	0	Read Only	–	v, s, i, p	0h1E19	4–108
UF.26	User function6	See UF.1 for Values	0: NOP	R/W	–	v, s, i, p	0h1E1A	4–108
UF.27	User function input6–A	0–0xFFFF	0	R/W	–	v, s, i, p	0h1E1B	4–108
UF.28	User function input6–B	0–0xFFFF	0	R/W	–	v, s, i, p	0h1E1C	4–108
UF.29	User function input6–C	0–0xFFFF	0	R/W	–	v, s, i, p	0h1E1D	4–108
UF.30	User function output6	–32767–32767	0	Read Only	–	v, s, i, p	0h1E1E	4–108

USER SEQUENCE FUNCTION Parameter Group (UF , USF)								
Pr. Code	Name	Setting Range	Initial Value	Run R/W	Parameter Dependency	Compatible Control Mode	Comm. Address (Hex)	Ref.
UF.31	User function7	See UF.1 for Values	0: NOP	R/W	–	v, s, i, p	0h1E1F	4–108
UF.32	User function input7–A	0–0xFFFF	0	R/W	–	v, s, i, p	0h1E20	4–108
UF.33	User function input7–B	0–0xFFFF	0	R/W	–	v, s, i, p	0h1E21	4–108
UF.34	User function input7–C	0–0xFFFF	0	R/W	–	v, s, i, p	0h1E22	4–108
UF.35	User function output7	–32767–32767	0	Read Only	–	v, s, i, p	0h1E23	4–108
UF.36	User function8	See UF.1 for Values	0: NOP	R/W	–	v, s, i, p	0h1E24	4–108
UF.37	User function input8–A	0–0xFFFF	0	R/W	–	v, s, i, p	0h1E25	4–108
UF.38	User function input8–B	0–0xFFFF	0	R/W	–	v, s, i, p	0h1E26	4–108
UF.39	User function input8–C	0–0xFFFF	0	R/W	–	v, s, i, p	0h1E27	4–108
UF.40	User function output8	–32767–32767	0	Read Only	–	v, s, i, p	0h1E28	4–108
UF.41	User function9	See UF.1 for Values	0: NOP	R/W	–	v, s, i, p	0h1E29	4–108
UF.42	User function input9–A	0–0xFFFF	0	R/W	–	v, s, i, p	0h1E2A	4–108
UF.43	User function input9–B	0–0xFFFF	0	R/W	–	v, s, i, p	0h1E2B	4–108
UF.44	User function input9–C	0–0xFFFF	0	R/W	–	v, s, i, p	0h1E2C	4–108
UF.45	User function output9	–32767–32767	0	Read Only	–	v, s, i, p	0h1E2D	4–108
UF.46	User function10	See UF.1 for Values	0: NOP	R/W	–	v, s, i, p	0h1E2E	4–108
UF.47	User function input10–A	0–0xFFFF	0	R/W	–	v, s, i, p	0h1E2F	4–108
UF.48	User function input10–B	0–0xFFFF	0	R/W	–	v, s, i, p	0h1E30	4–108
UF.49	User function input10–C	0–0xFFFF	0	R/W	–	v, s, i, p	0h1E31	4–108
UF.50	User function output10	–32767–32767	0	Read Only	–	v, s, i, p	0h1E32	4–108
UF.51	User function11	See UF.1 for Values	0: NOP	R/W	–	v, s, i, p	0h1E33	4–108
UF.52	User function input11–A	0–0xFFFF	0	R/W	–	v, s, i, p	0h1E34	4–108
UF.53	User function input11–B	0–0xFFFF	0	R/W	–	v, s, i, p	0h1E35	4–108
UF.54	User function input11–C	0–0xFFFF	0	R/W	–	v, s, i, p	0h1E36	4–108
UF.55	User function output11	–32767–32767	0	Read Only	–	v, s, i, p	0h1E37	4–108
UF.56	User function12	See UF.1 for Values	0: NOP	R/W	–	v, s, i, p	0h1E38	4–108
UF.57	User function input12–A	0–0xFFFF	0	R/W	–	v, s, i, p	0h1E39	4–108

USER SEQUENCE FUNCTION Parameter Group (UF , USF)								
Pr. Code	Name	Setting Range	Initial Value	Run R/W	Parameter Dependency	Compatible Control Mode	Comm. Address (Hex)	Ref.
UF.58	User function input12–B	0–0xFFFF	0	R/W	–	v, s, i, p	0h1E3A	4–108
UF.59	User function input12–C	0–0xFFFF	0	R/W	–	v, s, i, p	0h1E3B	4–108
UF.60	User function output12	–32767–32767	0	Read Only	–	v, s, i, p	0h1E3C	4–108
UF.61	User function13	See UF.1 for Values	0: NOP	R/W	–	v, s, i, p	0h1E3D	4–108
UF.62	User function input13–A	0–0xFFFF	0	R/W	–	v, s, i, p	0h1E3E	4–108
UF.63	User function input13–B	0–0xFFFF	0	R/W	–	v, s, i, p	0h1E3F	4–108
UF.64	User function input13–C	0–0xFFFF	0	R/W	–	v, s, i, p	0h1E40	4–108
UF.65	User function output13	–32767–32767	0	Read Only	–	v, s, i, p	0h1E41	4–108
UF.66	User function14	See UF.1 for Values	0: NOP	R/W	–	v, s, i, p	0h1E42	4–108
UF.67	User function input14–A	0–0xFFFF	0	R/W	–	v, s, i, p	0h1E43	4–108
UF.68	User function input14–B	0–0xFFFF	0	R/W	–	v, s, i, p	0h1E44	4–108
UF.69	User function input14–C	0–0xFFFF	0	R/W	–	v, s, i, p	0h1E45	4–108
UF.70	User function output14	–32767–32767	0	Read Only	–	v, s, i, p	0h1E46	4–108
UF.71	User function15	See UF.1 for Values	0: NOP	R/W	–	v, s, i, p	0h1E47	4–108
UF.72	User function input15–A	0–0xFFFF	0	R/W	–	v, s, i, p	0h1E48	4–108
UF.73	User function input15–B	0–0xFFFF	0	R/W	–	v, s, i, p	0h1E49	4–108
UF.74	User function input15–C	0–0xFFFF	0	R/W	–	v, s, i, p	0h1E4A	4–108
UF.75	User function output15	–32767–32767	0	Read Only	–	v, s, i, p	0h1E4B	4–108
UF.76	User function 16	See UF.1 for Values	0: NOP	R/W	–	v, s, i, p	0h1E4C	4–108
UF.77	User function input16–A	0–0xFFFF	0	R/W	–	v, s, i, p	0h1E4D	4–108
UF.78	User function input16–B	0–0xFFFF	0	R/W	–	v, s, i, p	0h1E4E	4–108
UF.79	User function input16–C	0–0xFFFF	0	R/W	–	v, s, i, p	0h1E4F	4–108
UF.80	User function output16	–32767–32767	0	Read Only	–	v, s, i, p	0h1E50	4–108
UF.81	User function 17	See UF.1 for Values	0: NOP	R/W	–	v, s, i, p	0h1E51	4–108
UF.82	User function input17–A	0–0xFFFF	0	R/W	–	v, s, i, p	0h1E52	4–108
UF.83	User function input17–B	0–0xFFFF	0	R/W	–	v, s, i, p	0h1E53	4–108
UF.84	User function input17–C	0–0xFFFF	0	R/W	–	v, s, i, p	0h1E54	4–108

USER SEQUENCE FUNCTION Parameter Group (UF , USF)								
Pr. Code	Name	Setting Range	Initial Value	Run R/W	Parameter Dependency	Compatible Control Mode	Comm. Address (Hex)	Ref.
UF.85	User function output17	–32767–32767	0	Read Only	–	v, s, i, p	0h1E55	4–108
UF.86	User function 18	See UF.1 for Values	0: NOP	R/W	–	v, s, i, p	0h1E56	4–108
UF.87	User function input18–A	0–0xFFFF	0	R/W	–	v, s, i, p	0h1E57	4–108
UF.88	User function input18–B	0–0xFFFF	0	R/W	–	v, s, i, p	0h1E58	4–108
UF.89	User function input18–C	0–0xFFFF	0	R/W	–	v, s, i, p	0h1E59	4–108
UF.90	User function output18	–32767–32767	0	Read Only	–	v, s, i, p	0h1E5A	4–108

Trip Mode (TRP Last-x)

The Trip Mode menu is only available on the LCD keypad. It will display only when there are active faults or fault history. It is labeled as follows:

- *n/a – standard LED kepyad*
- *TRP– optional LCD keypad*

See "Table Legend" on page 4–3 for details on each column in the table below.

Trip Mode (TRP Last-x)					
Pr. Code	**Name**	**Setting Range**		**Initial Value**	**Compatible Control Mode**
00	Trip type display	-		-	v, s, i, p
01	Frequency reference at trip	-		-	v, s, i, p
02	Output current at trip	-		-	v, s, i, p
03	Acceleration/Deceleration state at trip	-		-	v, s, i, p
04	DC section state	-		-	v, s, i, p
05	NTC temperature	-		-	v, s, i, p
06	Input terminal state	-		0000 0000	v, s, i, p
07	Output terminal state	-		000	v, s, i, p
08	Trip time after Power on	-		0/00/00 00:00	v, s, i, p
09	Trip time after operation start	-		0/00/00 00:00	v, s, i, p
10	Delete trip history	0	No		v, s, i, p
		1	Yes		

Config Mode (CNF)

The Config menu is only available on the LCD keypad. Config Mode menu is labeled as follows:

- *n/a – standard LED kepyad*
- *CNF. optional LCD keypad*

See "Table Legend" on page 4–3 for details on each column in the table below.

Config Mode (CNF)						
Pr. Code	**Name**	**Setting Range**		**Initial Value**	**Compatible Control Mode**	**Ref.**
0	Jump code	1-99		42	v, s, i, p	3–5
1	Keypad language selection	0 : English		0: English	v, s, i, p	4–194
2	LCD contrast adjustment	-		-	v, s, i, p	4–182
3	Multi keypad ID	3-99		3	v, s, i, p	4–107
10	Inverter (Drive) S/W version	-		-	v, s, i, p	4–182
11	LCD keypad S/W version	-		-	v, s, i, p	4–182
12	LCD keypad title version	-		-	v, s, i, p	4–182
20	Status window display item	0	Frequency	0: Frequency	v, s, i, p	4–195
		1	Speed			
		2	Output Current			
		3	Output Voltage			
		4	Output Power			
		5	WHour Counter			
		6	DCLink Voltage			
		7	DI State			
		8	DO State			
		9	V1 Monitor(V)			
		10	V1 Monitor(%)			
		13	V2 Monitor(V)			
		14	V2 Monitor(%)			
		15	I2 Monitor(mA)			
		16	I2 Monitor(%)			
		17	PID Output			
		18	PID Ref Value			
		19	PID Fdb Value			
		20	Torque			
		21	Torque Limit			
		23	Speed Limit			
		24	Load Speed			
		25	Temperature			
21	Monitor mode display item1	See code 20 for values		0: Frequency	v, s, i, p	4–195
22	Monitor mode display item2	See code 20 for values		2: Output Current	v, s, i, p	4–195
23	Monitor mode display item3	See code 20 for values		3: Output Voltage	v, s, i, p	4–195
24	Monitor mode initialization	0	No	0: No	v, s, i, p	4–195
		1	Yes			

Config Mode (CNF)						
Pr. Code	Name	Setting Range		Initial Value	Compatible Control Mode	Ref.
30	Option slot 1 type display	0	None	0: None	v, s, i, p	4–182
		6	Ethernet			
		9	CANopen			
31	Option slot 2 type display	See code 30 for values		0: None	v, s, i, p	4–182
32	Option slot 3 type display	See code 30 for values		0: None	v, s, i, p	4–182
40	Parameter initialization	0	No		v, s, i, p	4–177
		1	All Grp			
		2	DRV Grp			
		3	BAS Grp			
		4	ADV Grp			
		5	CON Grp			
		6	IN Grp			
		7	OUT Grp			
		8	COM Grp			
		9	APP Grp			
		11	APO Grp			
		12	PRT Grp			
		13	M2 Grp			
		14	USS Grp			
		15	USF Grp			
41	Display changed Parameter	0	View All	0: View All	v, s, i, p	4–180
		1	View Changed			
42	Multi key item	0	None	0: None	v, s, i, p	4–180
		1	JOG Key			
		2	Local/Remote			
		3	UserGrp SelKey			
		4	Multi KPD			
43	Macro function item	0	None	0: None	v, s, i, p	
44	Trip history deletion	0	No	0: No	v, s, i, p	4–182
		1	Yes			
45	User registration code deletion	0	No	0: No	v, s, i, p	4–180
		1	Yes			
46	Read parameters	0	No	0: No	v, s, i, p	4–177
		1	Yes			
47	Write parameters	0	No	0: No	v, s, i, p	4–177
		1	Yes			
48	Save parameters	0	No	0: No	v, s, i, p	4–177
		1	Yes			
50	Hide parameter mode	0-9999		Un-locked	v, s, i, p	4–178
51	Password for hiding parameter mode	0-9999		Password	v, s, i, p	4–178
52	Lock parameter edit	0-9999		Unlocked	v, s, i, p	4–178

Config Mode (CNF)						
Pr. Code	**Name**	**Setting Range**		**Initial Value**	**Compatible Control Mode**	**Ref.**
53	Password for locking parameter edit	0-9999		Password	v, s, i, p	4–178
60	Additional title update	0	No	0:No	v, s, i, p	4–182
		1	Yes			
61	Simple parameter setting	0	No	1:Yes	v, s, i, p	4–180
		1	Yes			
62	Power consumption initialization	0	No	0:No	v, s, i, p	4–182
		1	Yes			
70	Accumulated drive motion time	00000DAY 00:00		-	v, s, i, p	4–197
71	Accumulated drive operation time	00000DAY 00:00		-	v, s, i, p	4–197
72	Accumulated drive operation time initialization	0	No	0:No	v, s, i, p	4–197
		1	Yes			
74	Accumulated cooling fan operation time	00000DAY 00:00		-	v, s, i, p	4–197
75	Reset of accumulated cooling fan operation time	0	No	0:No	v, s, i, p	4–197
		1	Yes			
76	CPU Fan Time	00000DAY 00:00		–	v, s, i, p	
77	CPU Fan Time Reset	0	No	0: No	v, s, i, p	
		1	Yes			

IronHorse® ACN Drive Operation and Parameter Details

This section describes in detail the function of each parameter, parameter interaction, and how to configure drive functionality via parameters. There are 3 main sections:

1) Learning Basic Features
2) Learning Advanced Features
3) Learning Protection Features

Pr. Group	Pr. Code	Name	LCD Display	Parameter Setting	Setting Range	Unit
x	x	x	x	x	x	x

Chart Key

- *Group = Parameter Group, designated by one of the following:*
  - » *2 letter group abbreviation*
  - » *Operation (initial parameter group on Drive LED with no 2 letter designation)*
  - » *CNF (group available in optional LCD display only)*
- *Code = Parameter number, or full parameter group/code designation, i.e. dr.1*
- *Name = Parameter Description*
- *LCD Display = Parameter description seen on optional ACN-LCD display*
- *Parameter Setting = Applicable parameter setting value and function*
- *Setting Range = Full Range of parameter settings*
- *Unit = Engineering unit*

NOTE: Parameters can be restored to their default values using dr.93.

Learning Basic Features

This section describes the basic features of the ACN drive. Check the reference page in the table to see the detailed description for each of the advanced features.

Basic Tasks	Description	Ref.
Frequency reference source configuration for the keypad	Configures the drive to allow you to setup or modify frequency reference using the Keypad.	4–68
Frequency reference source configuration for the terminal block (input voltage)	Configures the drive to allow input voltages at the terminal block (V1, V2) and to setup or modify a frequency reference.	4–69 4–74
Frequency reference source configuration for the terminal block (input current)	Configures the drive to allow input currents at the terminal block (I2) and to setup or modify a frequency reference.	4–73
Frequency reference source configuration for the terminal block (input pulse)	Configures the drive to allow input pulse at the terminal block P5(TI) and to setup or modify a frequency reference.	4–75
Frequency reference source configuration for RS–485 communication	Configures the drive to allow communication signals from upper level controllers, such as PLCs or PCs, and to setup or modify a frequency reference.	4–76
Frequency control using analog inputs	Enables the user to hold a frequency using analog inputs at terminals.	4–76
Motor operation display options	Configures the display of motor operation values. Motor operation is displayed either in frequency (Hz) or speed (rpm).	4–77
Multi–step speed (frequency) configuration	Configures multi–step frequency operations by receiving an input at the terminals defined for each step frequency.	4–77
Command source configuration for keypad buttons	Configures the drive to allow the manual operation of the [FWD], [REV] and [Stop] keys.	4–79
Command source configuration for terminal block inputs (2-wire)	Configures the drive to accept inputs at the FX/RX terminals.	4–80
Command source configuration for RS–485 communication	Configures the drive to accept communication signals from upper level controllers, such as PLCs or PCs.	4–81
Local/remote switching via the [ESC] key	Configures the drive to switch between local and remote operation modes when the [ESC] key is pressed. When the drive is operated using remote inputs (any input other than one from the keypad), this configuration can be used to perform maintenance on the drive, without losing or altering saved parameter settings. It can also be used to override remotes and use the keypad immediately in emergencies.	4–82
Motor rotation control	Configures the drive to limit a motor's rotation direction.	4–84
Automatic start–up at power–on	Configures the drive to start operating at power–on. With this configuration, the drive begins to run and the motor accelerates as soon as power is supplied to the drive. To use automatic start–up configuration, the operation command terminals at the terminal block must be turned on.	4–85
Automatic restart after reset of a fault trip condition	Configures the drive to start operating when the drive is reset following a fault trip. In this configuration, the drive starts to run and the motor accelerates as soon as the drive is reset following a fault trip condition. For automatic start–up configuration to work, the operation command terminals at the terminal block must be turned on.	4–86
Acc/Dec time configuration based on the Max. Frequency	Configures the acceleration and deceleration times for a motor based on a defined maximum frequency.	4–87
Acc/Dec time configuration based on the frequency reference	Configures acceleration and deceleration times for a motor based on a defined frequency reference.	4–88
Multi–stage Acc/Dec time configuration using the multi–function terminal	Configures multi–stage acceleration and deceleration times for a motor based on defined parameters for the multi–function terminals.	4–88
Acc/Dec time transition speed (frequency) configuration	Enables modification of acceleration and deceleration gradients without configuring the multi–functional terminals.	4–89
Acc/Dec pattern configuration	Enables modification of the acceleration and deceleration gradient patterns. Basic patterns to choose from include linear and S–curve patterns.	4–91
Acc/Dec stop command	Stops the current acceleration or deceleration and controls motor operation at a constant speed. Multi–function terminals must be configured for this command .	4–93

Basic Tasks	Description	Ref.
Linear V/F pattern operation	Configures the drive to run a motor at a constant torque. To maintain the required torque, the operating frequency may vary during operation.	4–93
Square reduction V/F pattern operation	Configures the drive to run the motor at a square reduction V/F pattern. Fans and pumps are appropriate loads for square reduction V/F operation.	4–94
User V/F pattern configuration	Enables the user to configure a V/F pattern to match the characteristics of a motor. This configuration is for special–purpose motor applications to achieve optimal performance.	4–95
Manual torque boost	Manual configuration of the drive to produce a momentary torque boost. This configuration is for loads that require a large amount of starting torque, such as elevators or lifts.	4–97
Automatic torque boost	Automatic configuration of the drive that provides "auto tuning" that produces a momentary torque boost. This configuration is for loads that require a large amount of starting torque, such as elevators or lifts.	4–97
Output voltage adjustment	Adjusts the output voltage to the motor when the power supply to the drive differs from the motor's rated input voltage.	4–98
Accelerating start	Accelerating start is the general way to start motor operation. The typical application configures the motor to accelerate to a target frequency in response to a run command, however there may be other start or acceleration conditions defined.	4–98
Start after DC braking	Configures the drive to perform DC braking before the motor starts rotating again. This configuration is used when the motor will be rotating before the voltage is supplied from the drive.	4–98
Deceleration stop	Deceleration stop is the typical method used to stop a motor. The motor decelerates to 0Hz and stops on a stop command, however there may be other stop or deceleration conditions defined.	4–99
Stopping by DC braking	Configures the drive to apply DC braking during motor deceleration. The frequency at which DC braking occurs must be defined and during deceleration, when the motor reaches the defined frequency, DC braking is applied.	4–100
Free–run stop	Configures the drive to stop output to the motor using a stop command. The motor will free–run until it slows down and stops.	4–101
Power braking	Configures the drive to provide optimal, motor deceleration, without tripping over–voltage protection.	4–101
Start/maximum frequency configuration	Configures the frequency reference limits by defining a start frequency and a maximum frequency.	4–102
Upper/lower frequency limit configuration	Configures the frequency reference limits by defining an upper limit and a lower limit.	4–102
Frequency jump	Configures the drive to avoid running a motor in mechanically resonating frequencies.	4–103
2nd Operation Configuration	Used to configure the 2nd operation mode and switch between the operation modes according to your requirements.	4–104
Multi–function input terminal control configuration	Enables the user to improve the responsiveness of the multi–function input terminals.	4–105
P2P communication configuration	Configures the drive to share input and output devices with other drives.	4–106
Multi–keypad configuration	Enables the user to monitor multiple drives with one monitoring device.	4–107
User sequence configuration	Enables the user to implement simple sequences using various function blocks.	4–108

Setting Frequency Reference

The ACN drive provides several methods to setup and modify a frequency reference for an operation. The keypad, analog inputs [for example voltage (V1, V2) and current (I2) signals], or RS–485 (digital signals from higher–level controllers, such as PC or PLC) can be used. If UserSeqLink is selected, the common area can be linked with user sequence output and can be used as frequency reference.

Pr. Group	Pr. Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
Operation	Frq	Frequency reference source	Ref Freq Src	0	Keypad–1	0–12	–
				1	Keypad–2		
				2	V1		
				4	V2		
				5	I2		
				6	Int 485		
				8	Field Bus		
				9	UserSeqLink		
				12	Pulse		

Keypad as the Source (Keypad–1 setting)

You can modify frequency reference by using the keypad and apply changes by pressing the [ENT] key. To use the keypad as a frequency reference input source, go to the Frq (Frequency reference source) code in the Operation group and change the parameter value to 0 (Keypad–1). Input the frequency reference for an operation at the 0.00(Command Frequency) code in the Operation group.

Pr. Group	Pr. Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
Operation	Frq	Frequency reference source	Freq Ref Src	0	Keypad–1	0–12	–
	0.00	Frequency reference	–	0.00		Min to Max Frq*	Hz
You cannot set a frequency reference that exceeds the Max. Frequency, as configured with dr.20.							

Keypad as the Source (Keypad–2 setting)

You can use the Up Arrow and Down Arrow keys to modify a frequency reference. To use this as a second option, set the keypad as the source of the frequency reference, by going to the Frq (Frequency reference source) code in the Operation group and change the parameter value to 1 (Keypad–2). This allows frequency reference values to be increased or decreased by pressing the Up Arrow and Down Arrow keys.

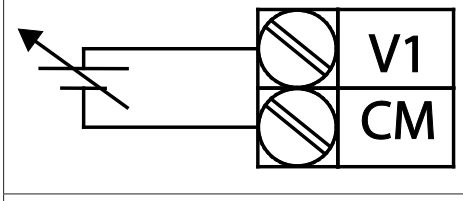
Pr. Group	Pr. Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
Operation	Frq	Frequency reference source	Freq Ref Src	1	Keypad–2	0–12	–
	0.00	Frequency reference	–	0.00		Min to Max Frq*	Hz
You cannot set a frequency reference that exceeds the Max. Frequency, as configured with dr.20.							

V1 Terminal as the Source

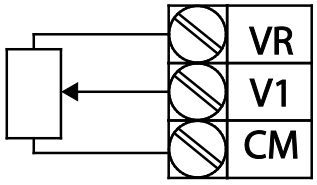
You can set and modify a frequency reference by setting voltage inputs when using the V1 terminal. Use voltage inputs ranging from 0 to 10V (unipolar) for forward only operation. Use voltage inputs ranging from –10 to +10V (bipolar) for both directions, where negative voltage inputs are used reverse operations.

Setting a Frequency Reference for 0–10V Input

Set In.6 (V1 Polarity) to 0 (unipolar). Use a voltage output from an external source or use the voltage output from the VR terminal to provide inputs to V1. Refer to the diagrams below for the wiring required for each application.



External source application

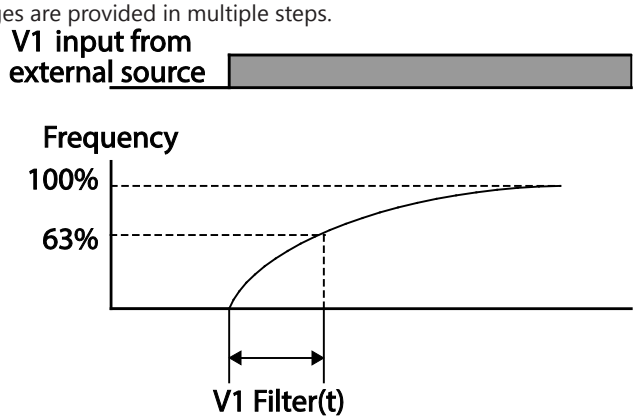
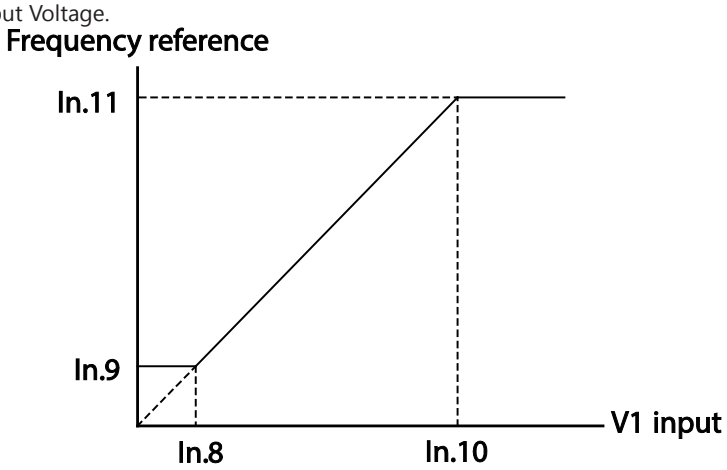


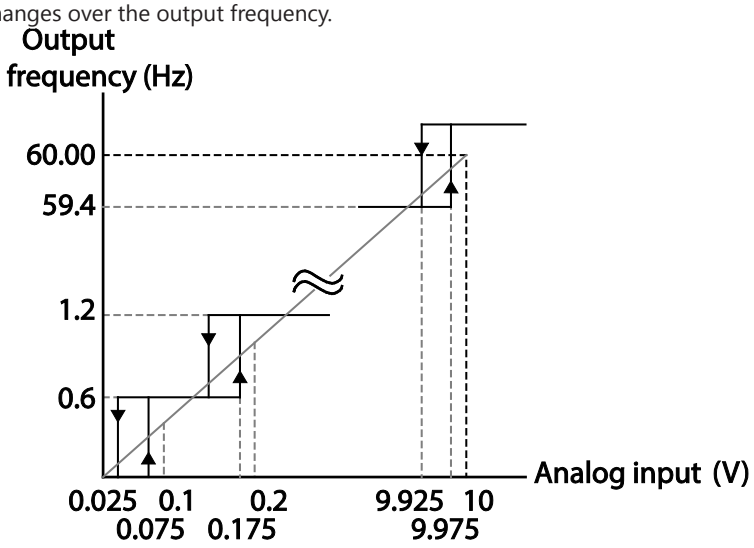
Internal source (VR) application

Pr. Group	Pr. Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
Operation	Frq	Frequency reference source	Freq Ref Src	2	V1	0–12	–
In	01	Frequency at maximum analog input	Freq at 100%	Maximum frequency		0.00– Max. Frequency	Hz
	05	V1 input monitor	V1 Monitor V	0.00		0.00–12.00	V
	06	V1 polarity options	V1 Polarity	0	Unipolar	0–1	–
	07	V1 input filter time constant	V1 Filter	10		0–10000	ms
	08	V1 minimum input voltage	V1 volt x1	0.00		0.00–10.00	V
	09	V1 output at minimum voltage (%)	V1 Perc y1	0.00		0.00–100.00	%
	10	V1 maximum input voltage	V1 Volt x2	10.00		0 .00– 12.00	V
	11	V1 output at maximum voltage (%)	V1 Perc y2	100.00		0–100	%
	16	Rotation direction options	V1 Inverting	0	No	0–1	–
	17	V1 Quantizing level	V1 Quantizing	0.04		0.00*, 0.04–10.00	%
Quantizing is disabled if '0' is selected.							

0–10V Input Voltage Setting Details

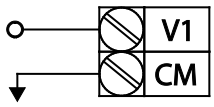
Pr. Code	Description
In.1 Freq at 100%	Configures the frequency reference at the maximum input voltage when a potentiometer is connected to the control terminal block. A frequency set with code In.1 becomes the maximum frequency only if the value set in code In.11 (or In.15) is 100%. Set code In.1 to 40.00 and use default values for codes In.2–In.16. Motor will run at 40.00 Hz when a 10V input is provided at V1. Set code In.11 to 50.00 and use default values for codes In.1–In.16. Motor will run at 30.00 Hz (50% of the default maximum frequency–60Hz) when a 10V input is provided at V1.
In.5 V1 MonitorV	Configures the drive to monitor the input voltage at V1.

Pr. Code	Description
In.7 V1 Filter	V1 Filter may be used when there are large variations between reference frequencies. Variations can be mitigated by increasing the time constant, but this will require an increased response time. The value t (time) indicates the time required for the frequency to reach 63% of the reference, when external input voltages are provided in multiple steps. 
In.8 V1 Volt x1– In.11 V1 Perc y2	These parameters are used to configure the gradient level and offset values of the Output Frequency, based on the Input Voltage. 
In.16 V1 Inverting	Inverts the direction of rotation. Set this code to 1 (Yes) if you need the motor to run in the opposite direction from the current rotation.

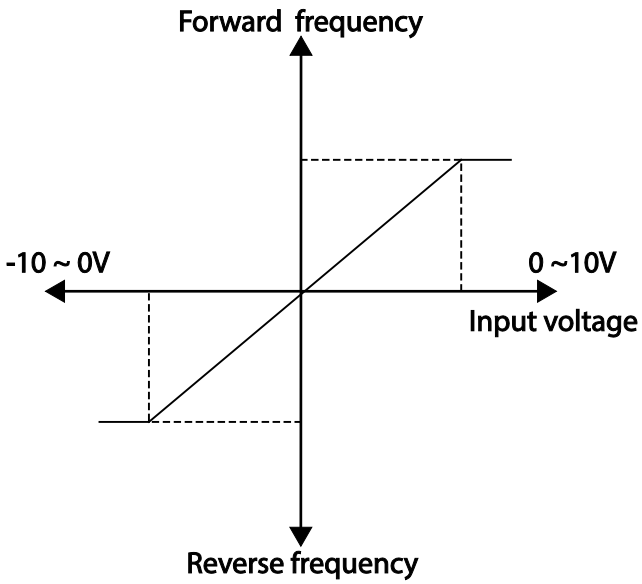
Pr. Code	Description
In.17 V1 Quantizing	Quantizing may be used when the noise level is high in the analog input (V1 terminal) signal. Quantizing is useful when you are operating a noise–sensitive system, because it suppresses any signal noise. However, quantizing will diminish system sensitivity (resultant power of the output frequency will decrease based on the analog input). You can also turn on the low–pass filter using code In.7 to reduce the noise, but increasing the value will reduce responsiveness and may cause pulsations (ripples) in the output frequency. Parameter values for quantizing refer to a percentage based on the maximum input. Therefore, if the value is set to 1% of the analog maximum input (60Hz), the output frequency will increase or decrease by 0.6 Hz per 0.1 V difference. When the analog input is increased, an increase to the input equal to 75% of the set value will change the output frequency, and then the frequency will increase according to the set value. Likewise, when the analog input decreases, a decrease in the input equal to 75% of the set value will make an initial change to the output frequency. As a result, the output frequency will be different at acceleration and deceleration, mitigating the effect of analog input changes over the output frequency. 

Setting a Frequency Reference for –10–10V Input

Set the Frq (Frequency reference source) code in the Operation group to 2 (V1), and then set In.6 (V1 Polarity) to 1 (bipolar). Use the output voltage from an external source to provide input to V1.



V1 terminal wiring



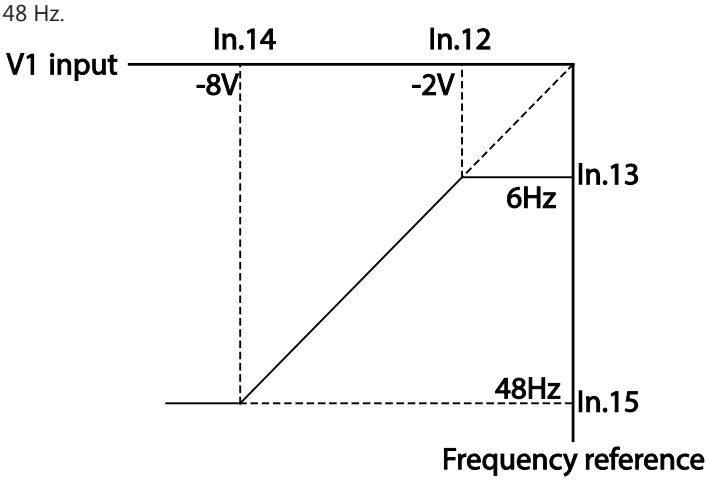
Bipolar input voltage and output frequency

Pr. Group	Pr. Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
Operation	Frq	Frequency reference source	Freq Ref Src	2	V1	0–12	–
In	01	Frequency at maximum analog input	Freq at 100%	60.00		0– Max Frequency	Hz
	05	V1 input monitor	V1 Monitor	0.00		0.00–12.00V	V
	06	V1 polarity options	V1 Polarity	1	Bipolar	0–1	–
	12	V1 minimum input voltage	V1– volt x1	0.00		10.00–0.00V	V
	13	V1 output at minimum voltage (%)	V1– Perc y1	0.00		–100.00–0.00%	%
	14	V1maximum input voltage	V1– Volt x2	–10.00		–12.00 –0.00V	V
	15	V1 output at maximum voltage (%)	V1– Perc y2	–100.00		–100.00–0.00%	%

Rotational Directions for Different Voltage Inputs

Command / Voltage Input	Input voltage	
	0–10V	–10–0V
FWD	Forward	Reverse
REV	Reverse	Forward

–10–10V Voltage Input Setting Details

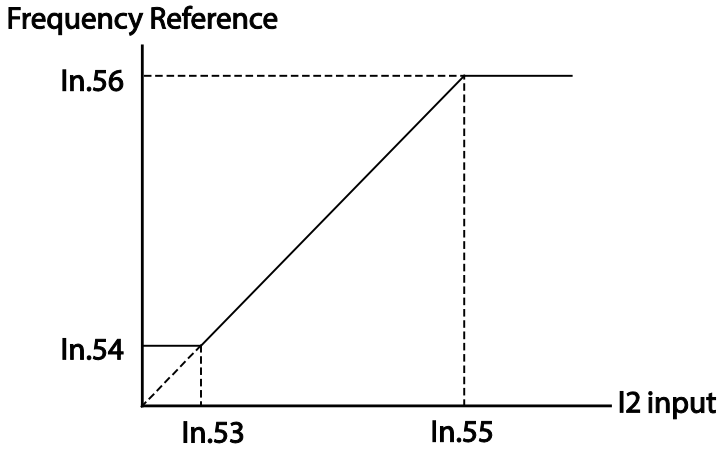
Pr. Code	Description
In.12 V1– volt x1– In.15 V1– Perc y2	Sets the gradient level and off–set value of the output frequency in relation to the input voltage. These codes are displayed only when In.6 is set to 1 (bipolar). As an example, if the minimum input voltage (at V1) is set to –2 (V) with 10% output ratio, and the maximum voltage is set to –8 (V) with 80% output ratio respectively, the output frequency will vary within the range of 6 – 48 Hz.  [In.12 V1–volt X1–In.15 V1 Perc y] For details about the 0–+10V analog inputs, Refer to "In.8 V1 Volt x1–" on page 4–70.

Setting a Reference Frequency using Input Current (I2)

You can set and modify a frequency reference using input current at the I2 terminal after selecting current input at SW 2. Set the Frq (Frequency reference source) code in the Operation group to 5 (I2) and apply 4–20 mA input current to I2.

Pr. Group	Pr. Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
Operation	Frq	Frequency reference source	Freq Ref Src	5	I2	0–12	–
In	01	Frequency at maximum analog input	Freq at 100%	60.00		0– Maximum Frequency	Hz
	50	I2 input monitor	I2 Monitor	0.00		0.00–24.00	mA
	52	I2 input filter time constant	I2 Filter	10		0–10000	ms
	53	I2 minimum input current	I2 Curr x1	4.00		0.00–20.00	mA
	54	I2 output at minimum current (%)	I2 Perc y1	0.00		0–100	%
	55	I2 maximum input current	I2 Curr x2	20.00		0.00–24.00	mA
	56	I2 output at maximum current (%)	I2 Perc y2	100.00		0.00–100.00	%
	61	I2 rotation direction options	I2 Inverting	0	No	0–1	–
	62	I2 Quantizing level	I2 Quantizing	0.04		0*, 0.04–10.00	%
**Quantizing is disabled if '0' is selected.*							

Input Current (I2) Setting Details

Pr. Code	Description
In.1 Freq at 100%	Configures the frequency reference for operation at the maximum current (when In.56 is set to 100%). If In.1 is set to 40.00Hz, and default settings are used for In.53–56, 20mA input current (max) to I2 will produce a frequency reference of 40.00 Hz. If In.56 is set to 50.00 (%), and default settings are used for In.1 (60Hz) and In.53–55, 20mA input current (max) to I2 will produce a frequency reference of 30.00 Hz (50% of 60Hz).
In.50 I2 Monitor	Used to monitor input current at I2.
In.52 I2 Filter	Configures the time for the operation frequency to reach 63% of target frequency based on the input current at I2.
In.53 I2 Curr x1–In.56 I2 Perc y2	Configures the gradient level and off–set value of the output frequency.  [Gradient and off–set configuration based on output frequency]

Setting a Frequency Reference with Input Voltage (Terminal I2)

Set and modify a frequency reference using input voltage at I2 (V2) terminal by setting SW2 to V2. Set the Frq (Frequency reference source) code in the Operation group to 4 (V2) and apply 0–12V input voltage to I2 (=V2, Analog current/voltage input terminal). Parameters In.35–47 will not be displayed when I2 is set to receive current input (Frq code parameter is set to 5).

Pr. Group	Pr. Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
Operation	Frq	Frequency reference source	Freq Ref Src	4	V2	0–12	–
In	35	V2 input display	V2 Monitor	0.00		0.00–12.00	V
	37	V2 input filter time constant	V2 Filter	10		0–10000	ms
	38	Minimum V2 input voltage	V2 Volt x1	0.00		0.00–10.00	V
	39	Output% at minimum V2 voltage	V2 Perc y1	0.00		0.00–100.00	%
	40	Maximum V2 input voltage	V2 Volt x2	10.00		0.00–10.00	V
	41	Output% at maximum V2 voltage	V2 Perc y2	100.00		0.00–100.00	%
	46	Invert V2 rotational direction	V2 Inverting	0	No	0–1	–
	47	V2 quantizing level	V2 Quantizing	0.04		0.00*, 0.04–10.00	%
**Quantizing is disabled if '0' is selected.*							

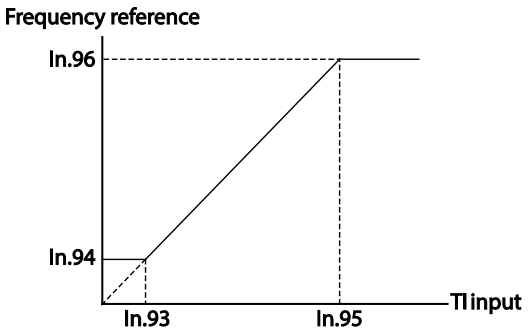
Setting a Frequency with TI Pulse Input

Set a frequency reference by setting the Frq (Frequency reference source) code in Operation group to 12 (Pulse). Set the In.69 P5 Define to 54(TI) and providing 0–32.00 kHz pulse frequency to P5.

Pr. Group	Pr. Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
Operation	Frq	Frequency reference source	Freq Ref Src	12	Pulse	0–12	–
In	69	P5 terminal function setting	P5 Define	54	TI	0–54	–
	01	Frequency at maximum analog input	Freq at 100%	60.00		0.00–Maximum frequency	Hz
	91	Pulse input display	Pulse Monitor	0.00		0.00–50.00	kHz
	92	TI input filter time constant	TI Filter	10		0–9999	ms
	93	TI input minimum pulse	TI Pls x1	0.00		0.00–32.00	kHz
	94	Output% at TI minimum pulse	TI Perc y1	0.00		0.00–100.00	%
	95	TI Input maximum pulse	TI Pls x2	32.00		0.00–32.00	kHz
	96	Output% at TI maximum pulse	TI Perc y2	100.00		0.00–100.00	%
	97	Invert TI direction of rotation	TI Inverting	0	No	0–1	–
	98	TI quantizing level	TI Quantizing	0.04		0.00*, 0.04–10.00	%

**Quantizing is disabled if '0' is selected.*

TI Pulse Input Setting Details

Pr. Code	Description
In.69 P5 Define	Pulse input TI and Multi–function terminal P5 share the same terminal. Set the In.69 P5 Define to 54(TI).
In.1 Freq at 100%	Configures the frequency reference at the maximum pulse input. The frequency reference is based on 100% of the value set with In.96. If In.1 Max Frequency is set to 40.00 and codes In.93–96 are set at default, 32kHz input to TI yields a frequency reference of 40.00 Hz. If In.96 is set to 50.00 and In.1 Max Freq is set to 60hz. (In.93–95 are set at default), 32kHz input to the TI terminal yields a frequency reference of 30.00 Hz.
In.91 Pulse Monitor	Displays the pulse frequency supplied at TI.
In.92 TI Filter	Sets the time for the pulse input at TI to reach 63% of its nominal frequency (when the pulse frequency is supplied in multiple steps).
In.93 TI Pls x1– In.96 TI Perc y2	Configures the gradient level and offset values for the output frequency. 
In.97 TI Inverting– In.98 TI Quantizing	Identical to In.16–17. Refer to "In.16 V1 Inverting" on page 4–70.

Setting a Frequency Reference via RS–485 Communication

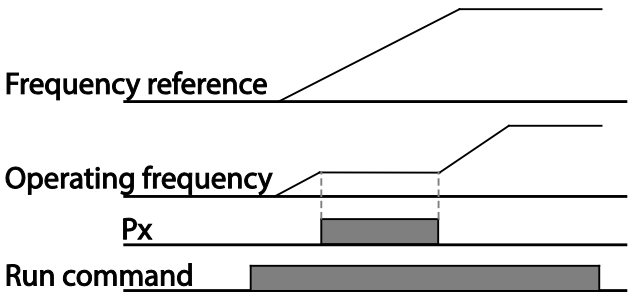
Control the drive with upper–level controllers, such as PCs or PLCs, via RS–485 communication. Set the Frq (Frequency reference source) code in the Operation group to 6 (Int 485) and use the RS–485 signal input terminals (S+/S–/SG) for communication. Refer to "Serial RS-485 Communication Features" on page 5–2.

Pr. Group	Pr. Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
Operation	Frq	Frequency reference source	Freq Ref Src	6	Int 485	0–12	–
CM	01	Integrated RS–485 communication drive ID	Int485 St ID	–	1	1–250	–
	02	Integrated communication protocol	Int485 Proto	0	ModBus RTU	0–2	–
				1	Reserved		
				2	Not supported		
	03	Integrated communication speed	Int485 BaudR	3	9600 bps	0–7	–
	04	Integrated communication frame configuration	Int485 Mode	0	D8/PN/S1	0–3	–
				1	D8/PN/S2		
				2	D8/PE/S1		
				3	D8/PO/S1		

Frequency Hold by Analog Input

If you set a frequency reference via analog input at the control terminal block, you can hold the operation frequency of the drive by assigning a multi–function input as the analog frequency hold terminal. The operation frequency will be fixed upon an analog input signal.

Pr. Group	Pr. Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
Operation	Frq	Frequency reference source	Freq Ref Src	0	Keypad–1	0–12	–
				1	Keypad–2		
				2	V1		
				4	V2		
				5	I2		
				6	Int 485		
				8	Field Bus		
				12	Pulse		
In	65–69	Px terminal configuration	Px Define(Px: P1–P5)	21	Analog Hold	0–54	–



Changing the Displayed Units (Hz↔Rpm)

You can change the units used to display the operational speed of the drive by setting dr.21 (Speed unit selection) to 0 (Hz) or 1 (Rpm). This function is available only with the LCD keypad.

Pr. Group	Pr. Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
dr	21	Speed unit selection	Hz/Rpm Sel	0	Hz Display	0–1	–
				1	Rpm Display		

Setting Multi–step Frequency

Multi–step operations can be carried out by assigning different speeds (or frequencies) to the Px terminals. Step 0 uses the frequency reference source set with the Frq code in the Operation group. Px terminal parameter values 7 (Speed–L), 8 (Speed–M) and 9 (Speed–H) are recognized as binary commands and work in combination with Fx or Rx run commands. The drive operates according to the frequencies set with St.1–3 (multi–step frequency 1–3) , bA.53–56 (multi–step frequency 4–7) and the binary command combinations.

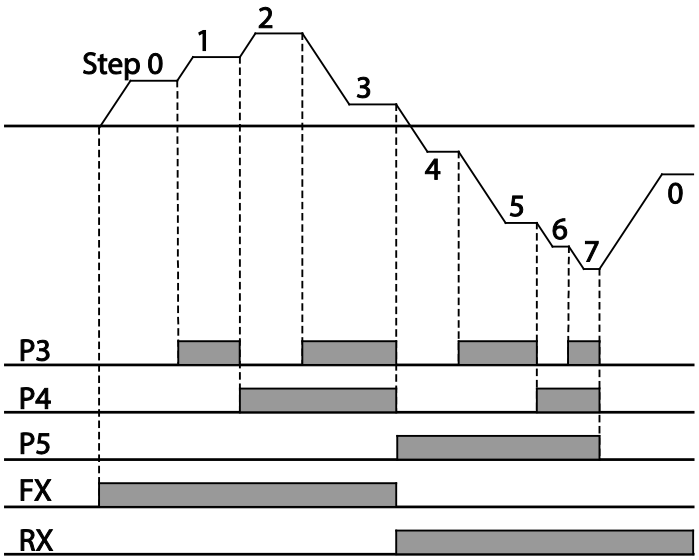
Pr. Group	Pr. Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
Operation	St1–St3	Multi–step frequency 1–3	Step Freq – 1–3	–		0–Maximum frequency	Hz
bA	53–56	Multi–step frequency 4–7	Step Freq – 4–7	–		0–Maximum frequency	Hz
In	65–69	Px terminal configuration	Px Define (Px: P1–P5)	7	Speed–L	0–54	–
				8	Speed–M		–
				9	Speed–H		–
	89	Multi–step command delay time	InCheck Time	1		1–5000	ms

Multi–step Frequency Setting Details

Pr. Code	Description
Operation group St1–St3 Step Freq – 1–3	Configure multi–step frequency1–3. If an LCD keypad is in use, bA.50–52 is used instead of St1–St3 (multi–step frequency 1–3).
bA.53–56 Step Freq – 4–7	Configure multi–step frequency 4–7.

<table>
<tr><th>Pr. Code</th><th>Description</th></tr>
<tr><td>In.65–69 Px Define</td><td>
Choose the terminals to setup as multi–step inputs, and then set the relevant codes (In.65–69) to 7(Speed–L), 8(Speed–M), or 9(Speed–H).

Provided that terminals P3, P4 and P5 have been set to Speed–L, Speed–M and Speed–H respectively, the following multi–step operation will be available.



[An example of a multi–step operation]
<table>
<tr><td>Speed</td><td>Fx/Rx</td><td>P5</td><td>P4</td><td>P3</td></tr>
<tr><td>0</td><td>X</td><td>–</td><td>–</td><td>–</td></tr>
<tr><td>1</td><td>X</td><td>–</td><td>–</td><td>X</td></tr>
<tr><td>2</td><td>X</td><td>–</td><td>X</td><td>–</td></tr>
<tr><td>3</td><td>X</td><td>–</td><td>X</td><td>X</td></tr>
<tr><td>4</td><td>X</td><td>X</td><td>–</td><td>–</td></tr>
<tr><td>5</td><td>X</td><td>X</td><td>–</td><td>X</td></tr>
<tr><td>6</td><td>X</td><td>X</td><td>X</td><td>–</td></tr>
<tr><td>7</td><td>X</td><td>X</td><td>X</td><td>X</td></tr>
</table>
</td></tr>
<tr><td>In.89 InCheck Time</td><td>
Set a time interval for the drive to check for additional terminal block inputs after receiving an input signal.

After adjusting In.89 to 100ms and an input signal is received at P5, the drive will search for inputs at other terminals for 100ms, before proceeding to accelerate or decelerate based on P5's configuration.
</td></tr>
</table>

Command Source Configuration

Various devices can be selected as command input devices for the ACN drive. Input devices available to select include keypad, multi–function input terminal, RS–485 communication and field bus adapter.

Pr. Group	Pr. Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
Operation	drv	Command Source	Cmd Source*	0	Keypad	0–5	–
				1	Fx/Rx–1 (Fwd Run/Rev Run)		
				2	Fx/Rx–2 (Run/ Direction)		
				3	Int 485		
				4	Field Bus		
				5	UserSeqLink		
Displayed under DRV–06 on the LCD keypad.							

The Keypad as a Command Input Device

The keypad can be selected as a command input device to send command signals to the drive. This is configured by setting the drv (command source) code to 0 (Keypad). Press the [RUN] key on the keypad to start an operation, and the [STOP/RESET] key to end it.

Pr. Group	Pr. Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
Operation	drv	Command source	Cmd Source*	0	Keypad	0–5	–
Displayed under DRV–06 on the LCD keypad.							

Terminal Block as a Command Input Device (Fwd/Rev Run Commands, 2-wire)

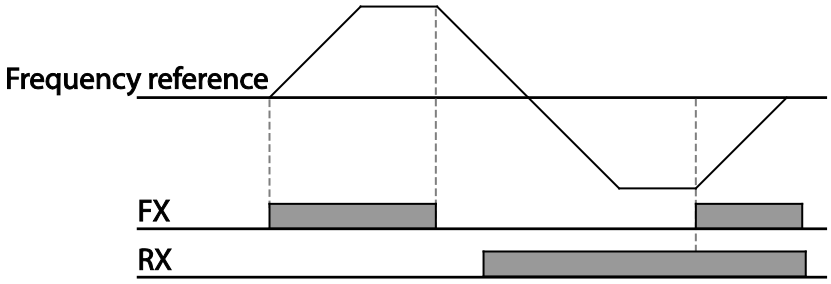
Multi–function terminals can be selected as a command input device. This is configured by setting the drv (command source) code in the Operation group to 1(Fx/Rx). Select 2 terminals for the forward and reverse operations, and then set the relevant codes (2 of the 5 multi–function terminal codes, In.65–69 for P1–P5) to 1(Fx) and 2(Rx) respectively. This application enables both terminals to be turned on or off at the same time, constituting a stop command that will cause the drive to stop operation.

Pr. Group	Pr. Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
Operation	drv	Command source	Cmd Source*	1	Fx/Rx–1 (Fwd Run/Rev Run)	0–5	–
In	65–69	Px terminal configuration	Px Define(Px: P1– P5)	1	Fx	0–54	–
				2	Rx		

**Displayed under DRV–06 on the LCD keypad.*

Fwd/Rev Command by Multi–function Terminal – Setting Details

Pr. Code	Description
Operation group drv–Cmd Source	Set to 1(Fx/Rx–1 (Fwd Run/Rev Run)).
In.65–69 Px Define	Assign a terminal for forward (Fx) operation. Assign a terminal for reverse (Rx) operation.



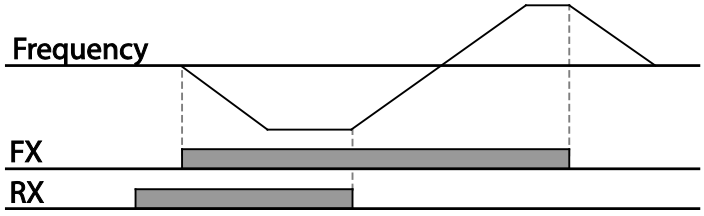
Terminal Block as a Command Input Device (Run and Rotation Direction Commands, 2-wire)

Multi–function terminals can be selected as a command input device. This is configured by setting the drv (command source) code in the Operation group to 2(Fx/Rx–2 (Run/Direction)). Select 2 terminals for run and rotation direction commands, and then select the relevant codes (2 of the 5 multi–function terminal codes, In.65–69 for P1–P5) to 1(Fx) and 2(Rx) respectively. This application uses an Fx input as a run command, and an Rx input to change a motor's rotation direction (On–Rx, Off–Fx).

Pr. Group	Pr. Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
Operation	Drv	Command source	Cmd Source*	2	Fx/Rx–2 (Run/ Direction)	0–5	–
In	65–69	Px terminal configuration	Px Define (Px: P1 – P5)	1	Fx	0–54	–
				2	Rx		
**Displayed under DRV–06 on the LCD keypad.*							

Run Command and Fwd/Rev Change Command Using Multi–function Terminal – Setting Details

Pr. Code	Description
Operation group drv Cmd Source	Set to 2(Fx/Rx–2 (Run/Direction)).
In.65–69 Px Define	Assign a terminal for run command (Fx). Assign a terminal for changing rotation direction (Rx).



RS–485 Communication as a Command Input Device

Internal RS–485 communication can be selected as a command input device by setting the drv (command source) code in the Operation group to 3(Int 485). This configuration uses upper level controllers such as PCs or PLCs to control the drive by transmitting and receiving signals via the S+, S–, and Sg terminals at the terminal block. For more details, refer to "Serial RS-485 Communication Features" on page 5–2.

Pr. Group	Pr. Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
Operation	drv	Command source	Cmd Source*	3	Int 485	0–5	–
CM	01	Integrated communication drive ID	Int485 St ID	1		1–250	–
	02	Integrated communication protocol	Int485 Proto	0	ModBus RTU	0–2	–
	03	Integrated communication speed	Int485 BaudR	3	9600 bps	0–7	–
	04	Integrated communication frame setup	Int485 Mode	0	D8 / PN / S1	0–3	–
**Displayed under DRV–06 on the LCD keypad.*							

Local/Remote Mode Switching

Local/remote switching is useful for checking the operation of the drive or to perform an inspection while retaining all parameter values. Also, in an emergency, it can also be used to override control and operate the system manually using the keypad.

The [ESC] key is a programmable key that can be configured to carry out multiple functions. For more details, refer "Configuring the [ESC] Key" on page 3–9.

Pr. Group	Pr. Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
dr	90	[ESC] key functions	–	2	Local/Remote	0–2	–
Operation	drv	Command source	Cmd Source*	1	Fx/Rx–1 (Fwd Run/ Rev Run)	0–5	–
Displayed under DRV–06 on the LCD keypad.							

Local/Remote Mode Switching Setting Details

Pr. Code	Description
dr.90 [ESC] key functions	Set dr.90 to 2(Local/Remote) to perform local/remote switching using the [ESC] key. Once the value is set, the drive will automatically begin operating in remote mode. Changing from local to remote will not alter any previously configured parameter values and the operation of the drive will not change. Press the [ESC] key to switch the operation mode back to "local." The SET light will flash, and the drive will operate using the [RUN] key on the keypad. Press the [ESC] key again to switch the operation mode back to "remote." The SET light will turn off and the drive will operate according to the previous drv code configuration.

NOTE:
Local/Remote Operation

- *Full control of the drive is available with the keypad during local operation (local operation).*
- *During local operation, jog commands will only work if one of the P1-P5 multi-function terminals (codes In.65-69) is set to 13(RUN Enable) and the relevant terminal is turned on.*
- *During remote operation (remote operation), the drive will operate according to the previously set frequency reference source and the command received from the input device.*
- *If Ad.10 (power-on run) is set to 0(No), the drive will NOT operate on power-on even when the following terminals are turned on:*
  - *-Fwd/Rev run (Fx/Rx) terminal*
  - *-Fwd/Rev jog terminal (Fwd jog/Rev Jog)*
  - *-Pre-Excitation terminal*
- *To operate the drive manually with the keypad, switch to local mode. Use caution when switching back to remote operation mode as the drive will stop operating. If Ad.10 (power-on run) is set to 0(No), a command through the input terminals will work ONLY AFTER all the terminals listed above have been turned off and then turned on again.*
- *If the drive has been reset to clear a fault trip during an operation, the drive will switch to local operation mode at power-on, and full control of the drive will be with the keypad. The drive will stop operating when operation mode is switched from "local" to "remote". In this case, a run command through an input terminal will work ONLY AFTER all the input terminals have been turned off.*

Drive Operation During Local/Remote Switching
Switching operation mode from "remote" to "local" while the drive is running will cause the drive to stop operating. Switching operation mode from "local" to "remote" however, will cause the drive to operate based on the command source:

- *Analog commands via terminal input: the drive will continue to run without interruption based on the command at the terminal block. If a reverse operation (Rx) signal is ON at the terminal block at startup, the drive will operate in the reverse direction even if it was running in the forward direction in local operation mode before the reset.*
- *Digital source commands: all command sources except terminal block command sources (which are analog sources) are digital command sources that include the keypad, LCD keypad, and communication sources. The drive stops operation when switching to remote operation mode, and then starts operation when the next command is given.*

WARNING: USE LOCAL/REMOTE OPERATION MODE SWITCHING ONLY WHEN IT IS NECESSARY. IMPROPER MODE SWITCHING MAY RESULT IN INTERRUPTION OF THE DRIVE'S OPERATION.

Forward or Reverse Run Prevention

The rotation direction of motors can be configured to run in only one direction. Pressing the [REV] key on the LCD keypad when direction prevention is configured, will cause the motor to decelerate to 0Hz and stop. The drive will remain on.

Pr. Group	Pr. Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
Ad	09	Run prevention options	Run Prevent	0	None	0–2	–
				1	Forward Prev		
				2	Reverse Prev		

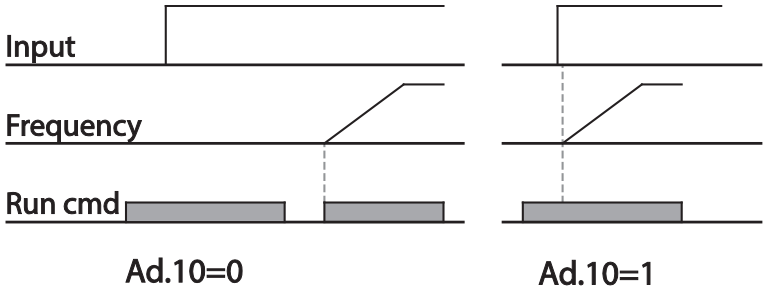
Forward/Reverse Run Prevention Setting Details

Pr. Code	Description		
Ad.9 Run Prevent	Choose a direction to prevent.		
	Setting		Description
	0	None	Do not set run prevention.
	1	Forward Prev	Set forward run prevention.
	2	Reverse Prev	Set reverse run prevention.

Power–on Run

A power–on command can be setup to start an drive operation after powering up, based on terminal block operation commands (if they have been configured). To enable power–on run set the drv (command source) code to 1(Fx/Rx–1 (Fwd Run/Rev Run)) or 2 (Fx/Rx–2 (Run/Direction)) in the Operation group.

Pr. Group	Pr. Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
Operation	drv	Command source	Cmd Source*	1, 2	Fx/Rx–1 (Fwd Run/Rev Run) or Fx/Rx–2 (Run/ Direction)	0–5	–
Ad	10	Power–on run	Power–on Run	1	Yes	0–1	–
Displayed under DRV–06 on the LCD keypad.							



NOTE:

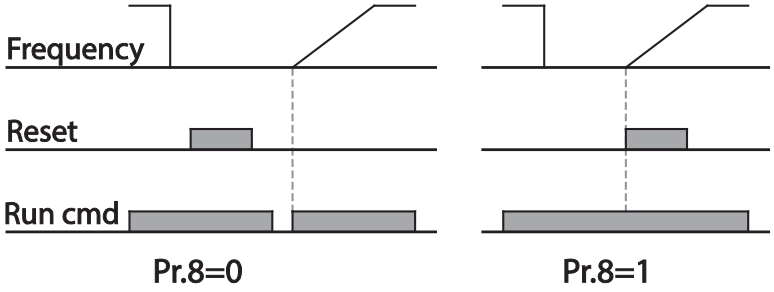
- *A fault trip may be triggered if the drive starts operation while a motor's load (fan-type load) is in free-run state. To prevent this from happening, set parameter Cn.71 (speed search options), Bit 4 = 1. The drive will perform a speed search at the beginning of the operation.*
- *If the speed search is not enabled, the drive will begin its operation in a normal V/F pattern and accelerate the motor. If the drive has been turned on without power-on run enabled, the terminal block command must first be turned off, and then turned on again to begin the drive's operation.*

CAUTION: Use caution when operating the drive with Power–on Run enabled as the motor will begin rotating when the drive starts up.

Reset and Restart

Reset and restart operations can be setup for drive operation following a fault trip, based on the terminal block operation command (if it is configured). When a fault trip occurs, the drive cuts off the output and the motor will free–run. Another fault trip may be triggered if the drive begins its operation while motor load is in a free–run state.

Pr. Group	Pr. Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
Operation	drv	Command source	Cmd Source*	1 2	Fx/Rx–1 (Fwd Run/Rev Run) or Fx/Rx–2 (Run/Direction)	0–5	–
Pr	08	Reset restart setup	RST Restart	1	Yes	0–1	–
	09	No. of auto restart	Retry Number	0	–	0–10	–
	10	Auto restart delay time	Retry Delay	1.0	–	0–60	sec
**Displayed under DRV–06 in an LCD keypad.*							



NOTE:

- *To prevent a repeat fault trip from occurring, set Cn.71 (speed search options) bit 2 = 1. The drive will perform a speed search at the beginning of the operation.*
- *If the speed search is not enabled, the drive will start its operation in a normal V/F pattern and accelerate the motor. If the drive has been turned on without 'reset and restart' enabled, the terminal block command must be first turned off, and then turned on again to begin the drive's operation.*

CAUTION: Use caution when operating the drive with Power–on Run enabled as the motor will begin rotating when the drive starts up..

Setting Acceleration and Deceleration Times

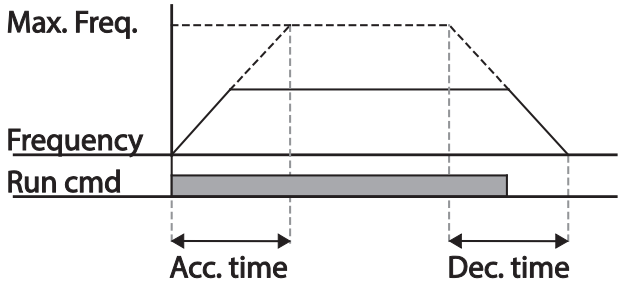
Acc/Dec Time Based on Maximum Frequency

Acc/Dec time values can be set based on maximum frequency, not on drive operation frequency. To set Acc/Dec time values based on maximum frequency, set bA.8 (Acc/Dec reference), = 0 (Max Freq).

Acceleration time set at the ACC (Acceleration time) code in the Operation group (dr.3 in an LCD keypad) refers to the time required for the drive to reach the maximum frequency from a stopped (0Hz) state. Likewise, the value set at the dEC (deceleration time) parameter in the Operation group (dr.4 in an LCD keypad) refers to the time required to return to a stopped state (0Hz) from the maximum frequency.

Pr. Group	Pr. Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
Operation	ACC	Acceleration time	Acc Time	20.0		0.0–600.0	sec
	dEC	Deceleration time	Dec Time	30.0		0.0–600.0	sec
	20	Maximum frequency	Max Freq	60.00		40.00–400.00	Hz
bA	08	Acc/Dec reference frequency	Ramp T Mode	0	Max Freq	0–1	–
	09	Time scale	Time scale	1	0.1sec	0–2	–

Acc/Dec Time Based on Maximum Frequency – Setting Details

<table>
<tr><th>Pr. Code</th><th>Description</th></tr>
<tr><td>bA.8
Ramp T Mode</td><td>Set the parameter value to 0 (Max Freq) to setup Acc/Dec time based on maximum frequency.
<table>
<tr><td colspan="2">Configuration</td><td>Description</td></tr>
<tr><td>0</td><td>Max Freq</td><td>Set the Acc/Dec time based on maximum frequency.</td></tr>
<tr><td>1</td><td>Delta Freq</td><td>Set the Acc/Dec time based on operating frequency.</td></tr>
</table>
If, for example, maximum frequency is 60.00Hz, the Acc/Dec times are set to 5 seconds, and the frequency reference for operation is set at 30Hz (half of 60Hz), the time required to reach 30Hz therefore is 2.5 seconds (half of 5 seconds).

</td></tr>
<tr><td>bA.9 Time scale</td><td>Use the time scale for all time–related values. It is particularly useful when a more accurate Acc/Dec times are required because of load characteristics, or when the maximum time range needs to be extended.
<table>
<tr><td colspan="2">Configuration</td><td>Description</td></tr>
<tr><td>0</td><td>0.01sec</td><td>Sets 0.01 second as the minimum unit.</td></tr>
<tr><td>1</td><td>0.1sec</td><td>Sets 0.1 second as the minimum unit.</td></tr>
<tr><td>2</td><td>1sec</td><td>Sets 1 second as the minimum unit.</td></tr>
</table></td></tr>
</table>

CAUTION: Note that the range of maximum time values may change automatically when the units are changed. If for example, the acceleration time is set at 6000 seconds, a time scale change from 1 second to 0.01 second will result in a modified acceleration time of 60.00 seconds.

Acc/Dec Time Based on Operation Frequency

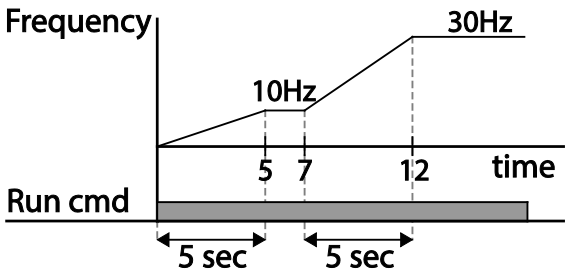
Acc/Dec times can be set based on the time required to reach the next step frequency from the existing operation frequency. To set the Acc/Dec time values based on the existing operation frequency, set bA. 08 (acc/dec reference),= 1 (Delta Freq).

Pr. Group	Pr. Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
Operation	ACC	Acceleration time	Acc Time	20.0		0.0–600.0	sec
	dEC	Deceleration time	Dec Time	30.0		0.0–600.0	sec
bA	08	Acc/Dec reference	Ramp T Mode	1	Delta Freq	0–1	–

Acc/Dec Time Based on Operation Frequency – Setting Details

Pr. Code	Description
bA.8 Ramp T Mode	Set the parameter value to 1 (Delta Freq) to set Acc/Dec times based on Maximum frequency.

Configuration		Description
0	Max Freq	Set the Acc/Dec time based on Maximum frequency
1	Delta Freq	Set the Acc/Dec time based on Operation Frequency



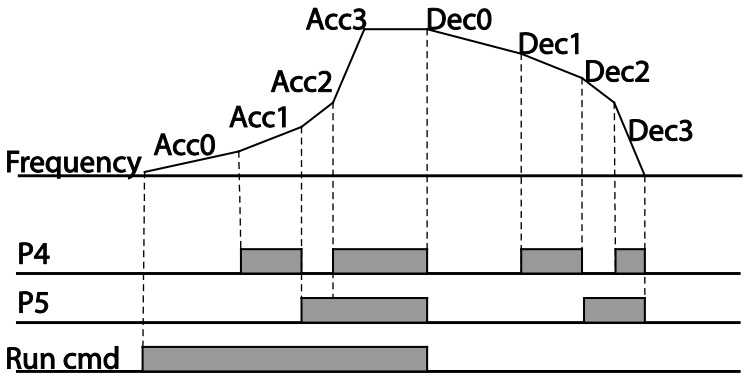
If Acc/Dec times are set to 5 seconds, and multiple frequency references are used in the operation in 2 steps, at 10Hz and 30 Hz, each acceleration stage will take 5 seconds (refer to the graph below).

Multi–step Acc/Dec Time Configuration

Acc/Dec times can be configured via a multi–function terminal by setting the ACC (acceleration time) and dEC (deceleration time) codes in the Operation group.

Pr. Group	Pr. Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
Operation	ACC	Acceleration time	Acc Time	20.0		0.0–600.0	sec
	dEC	Deceleration time	Dec Time	30.0		0.0–600.0	sec
bA	70–82	Multi–step acceleration time1–7	Acc Time 1–7	x.xx		0.0–600.0	sec
	71–83	Multi–step deceleration time1–7	Dec Time 1–7	x.xx		0.0–600.0	sec
In	65–69	Px terminal configuration	Px Define (Px: P1–P5)	11	XCEL–L	0–54	–
				12	XCEL–M		
				49	XCEL–H		
	89	Multi–step command delay time	In Check Time	1		1–5000	ms

Acc/Dec Time Setup via Multi–function Terminals – Setting Details

<table>
<tr><th>Pr. Code</th><th colspan="3">Description</th></tr>
<tr><td>bA. 70–82 Acc Time 1–7</td><td colspan="3">Set multi–step acceleration time1–7.</td></tr>
<tr><td>bA.71–83 Dec Time 1–7</td><td colspan="3">Set multi–step deceleration time1–7.</td></tr>
<tr><td rowspan="11">In.65–69
Px Define (P1–P5)</td><td colspan="3">Choose and configure the terminals to use for multi–step Acc/Dec time inputs.</td></tr>
<tr><td colspan="2">Configuration</td><td>Description</td></tr>
<tr><td>11</td><td>XCEL–L</td><td>Acc/Dec command–L</td></tr>
<tr><td>12</td><td>XCEL–M</td><td>Acc/Dec command–M</td></tr>
<tr><td>49</td><td>XCEL–H</td><td>Acc/Dec command–H</td></tr>
<tr><td colspan="3">Acc/Dec commands are recognized as binary code inputs and will control the acceleration and deceleration based on parameter values set with bA.70–82 and bA.71–83.
If, for example, the P4 and P5 terminals are set as XCEL–L and XCEL-M respectively, the following operation will be available.
 
</td></tr>
<tr><td>Acc/Dec time</td><td>P5</td><td>P4</td></tr>
<tr><td>0</td><td>–</td><td>–</td></tr>
<tr><td>1</td><td>–</td><td>X</td></tr>
<tr><td>2</td><td>X</td><td>–</td></tr>
<tr><td>3</td><td>X</td><td>X</td></tr>
<tr><td>In.89 In Check Time</td><td colspan="3">Set the time for the drive to check for other terminal block inputs. If In.89 is set to 100ms and a signal is supplied to the P4 terminal, the drive searches for other inputs over the next 100ms. When the time expires, the Acc/Dec time will be set based on the input received at P4.</td></tr>
</table>

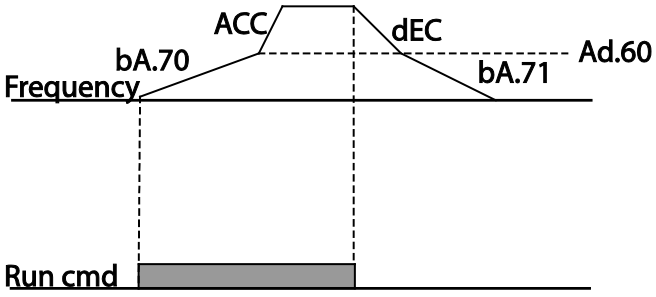
Configuring Acc/Dec Time Switch Frequency

You can switch between two different sets of Acc/Dec times (Acc/Dec gradients) by configuring the switch frequency without configuring the multi–function terminals.

Pr. Group	Pr. Code	Name	LCD Display	Parameter Setting	Setting Range	Unit
Operation	ACC	Acceleration time	Acc Time	10.0	0.0–600.0	sec
	dEC	Deceleration time	Dec Time	10.0	0.0–600.0	sec
bA	70	Multi–step acceleration time1	Acc Time–1	20.0	0.0–600.0	sec
	71	Multi–step deceleration time1	Dec Time–1	20.0	0.0–600.0	sec
Ad	60	Acc/Dec time switch frequency	Xcel Change Frq	30.00	0–Maximum frequency	Hz

Acc/Dec Time Switch Frequency Setting Details

Pr. Code	Description
Ad.60 ***Xcel Change Fr***	After the Acc/Dec switch frequency has been set, Acc/Dec gradients configured at bA.70 and 71 will be used when the drive's operation frequency is at or below the switch frequency. If the operation frequency exceeds the switch frequency, the configured gradient level, configured for the ACC and dEC codes, will be used. If you configure the P1–P5 multi–function input terminals for multi–step Acc/Dec gradients (XCEL–L, XCEL–M, XCEL–H), the drive will operate based on the Acc/Dec inputs at the terminals instead of the Acc/Dec switch frequency configurations.



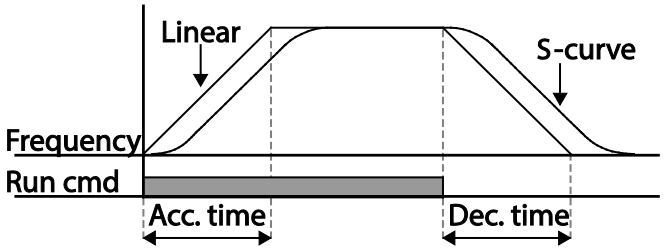
Acc/Dec Pattern Configuration

Acc/Dec gradient level patterns can be configured to enhance and smooth the drive's acceleration and deceleration curves. Linear pattern features a linear increase or decrease to the output frequency, at a fixed rate. For an S–curve pattern a smoother and more gradual increase or decrease of output frequency, ideal for lift–type loads or elevator doors, etc. S–curve gradient level can be adjusted using codes Ad. 03–06 in the Advanced group.

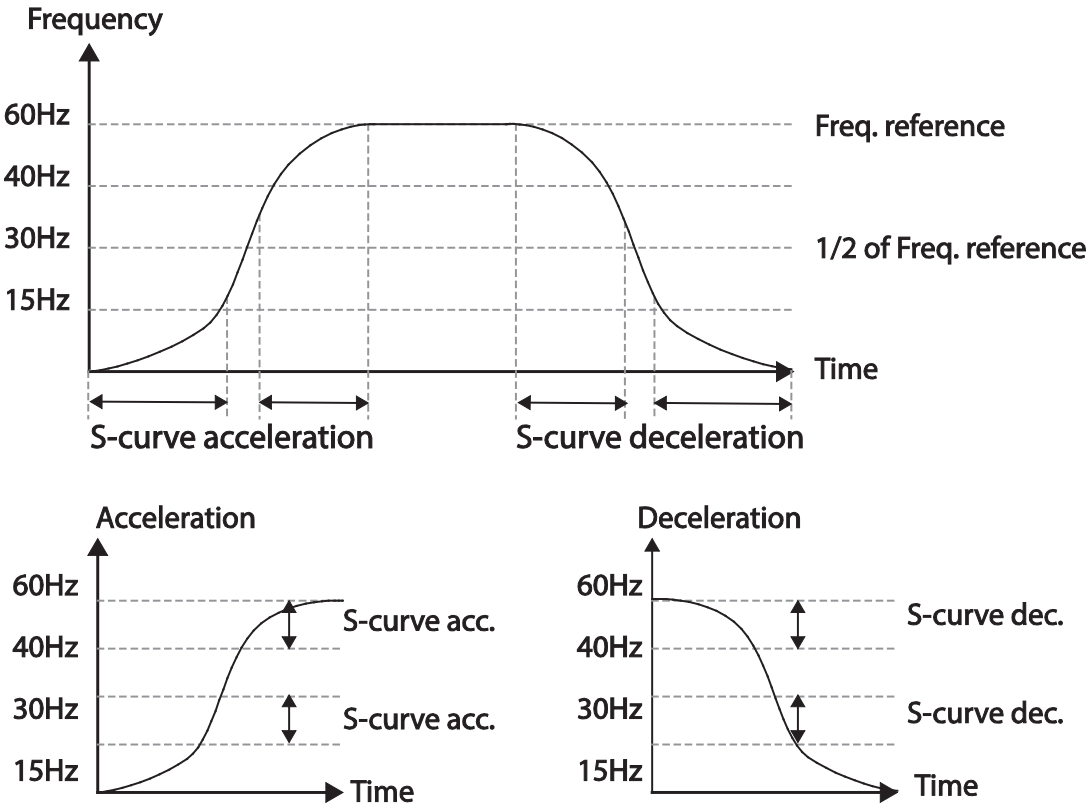
Pr. Group	Pr. Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
bA	08	Acc/Dec reference	Ramp T mode	0	Max Freq	0–1	–
Ad	01	Acceleration pattern	Acc Pattern	0	Linear	0–1	–
	02	Deceleration pattern	Dec Pattern	1	S–curve		–
	03	S–curve Acc start gradient	Acc S Start	40		1–100	%
	04	S–curve Acc end gradient	Acc S End	40		1–100	%
	05	S–curve Dec start gradient	Dec S Start	40		1–100	%
	06	S–curve Dec end gradient	Dec S End	40		1–100	%

Acc/Dec Pattern Setting Details

Pr. Code	Description
Ad.3 Acc S Start	Sets the gradient level as acceleration starts when using an S–curve, Acc/Dec pattern. Ad. 03 defines S–curve gradient level as a percentage, up to half of total acceleration. If the frequency reference and maximum frequency are set at 60Hz and Ad.3 is set to 50%, Ad. 03 configures acceleration up to 30Hz (half of 60Hz).The drive will operate S–curve acceleration in the 0–15 Hz frequency range (50% of 30Hz). Linear acceleration will be applied to the remaining acceleration within the 15–30 Hz frequency range.
Ad.4 Acc S End	Sets the gradient level as acceleration ends when using an S–curve Acc/Dec pattern. Ad. 03 defines S–curve gradient level as a percentage, above half of total acceleration. If the frequency reference and the maximum frequency are set at 60Hz and Ad.4 is set to 50%, setting Ad. 04 configures acceleration to increase from 30Hz (half of 60Hz) to 60Hz (end of acceleration). Linear acceleration will be applied within the 30–45 Hz frequency range. The drive will perform an S–curve acceleration for the remaining acceleration in the 45–60 Hz frequency range.
Ad.5 Dec S Start – Ad.6 Dec S End	Sets the rate of S–curve deceleration. Configuration for codes Ad.5 and Ad.6 may be performed the same way as configuring codes Ad.3 and Ad.4.



Acceleration / deceleration pattern configuration



Acceleration / deceleration S–curve pattern configuration

NOTE:
The Actual Acc/Dec time during an S-curve application:

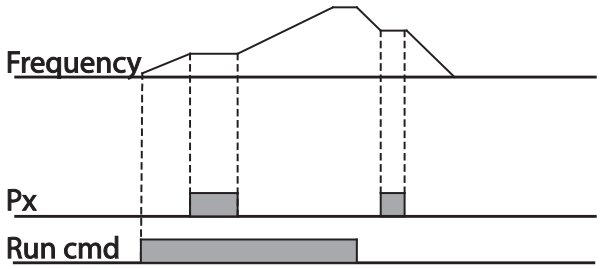
- *Actual acceleration time = user-configured acceleration time + user-configured acceleration time x starting gradient level/2 + user-configured acceleration time x ending gradient level/2.*
- *Actual deceleration time = user-configured deceleration time + user-configured deceleration time x starting gradient level/2 + user-configured deceleration time x ending gradient level/2*

CAUTION: NOTE THAT ACTUAL ACC/DEC TIMES BECOME GREATER THAN USER DEFINED ACC/DEC TIMES WHEN S–CURVE ACC/DEC PATTERNS ARE IN USE.

STOPPING THE ACC/DEC OPERATION

Configure the multi–function input terminals to stop acceleration or deceleration and operate the drive at a fixed frequency.

Pr. Group	Pr. Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
In	65–69	Px terminal configuration	Px Define(Px: P1– P5)	25	XCEL Stop	0–54	–



V/F (Voltage/Frequency) Control

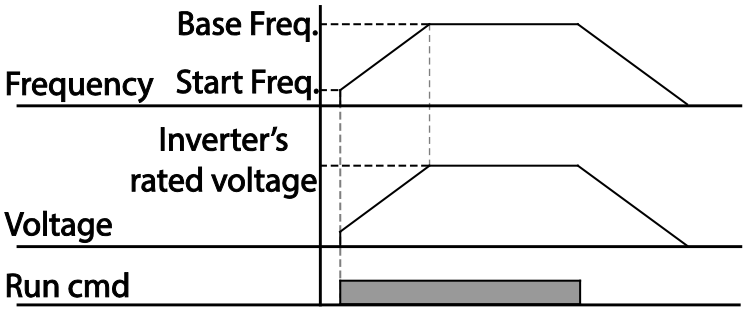
Configure the drive's output voltages, gradient levels and output patterns to achieve a target output frequency with V/F control. The amount of torque boost used during low frequency operations can also be adjusted.

Linear V/F Pattern Operation

A linear V/F pattern configures the drive to increase or decrease the output voltage at a fixed rate for different operation frequencies based on V/F characteristics. A linear V/F pattern is particularly useful when a constant torque load is applied.

Pr. Group	Pr. Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
dr	09	Control mode	Control Mode	0	V/F	0–4	–
	18	Base frequency	Base Freq	60.00		30.00–400.00	Hz
	19	Start frequency	Start Freq	0.50		0.01–10.00	Hz
bA	07	V/F pattern	V/F Pattern	0	Linear	0–3	–
In	65–67	Px terminal configuration	Px terminal configuration	34	Pre Excitation	0–54	–

Linear V/F Pattern Setting Details

Pr. Code	Description
dr.18 Base Freq	Sets the base frequency. A base frequency is the drive's output frequency when running at its rated voltage. Refer to the motor's rating plate to set this parameter value.
dr.19 Start Freq	Sets the start frequency. A start frequency is a frequency at which the drive starts voltage output. The drive does not produce output voltage while the frequency reference is lower than the set frequency. However, if a deceleration stop is made while operating above the start frequency, output voltage will continue until the operation frequency reaches a full–stop (0Hz). 

Pre Excitation in V/F Mode

Pre-excitation allows current to flow to the stator coil to energize the motor flux before the start command. Cn.09 and Cn.10 control pre-exciation and are automatically active in Sensorless Vector control mode. The Pre-excitation of the motor can be configured in V/F mode with the use of the mulitfunction input parameter. Set any MF input In.65-69 to 34- Pre-Excite. When the bit is energized, Cn.9 and Cn.10 parameters will be used. See sensorless vector control mode for more information on pre-excitation.

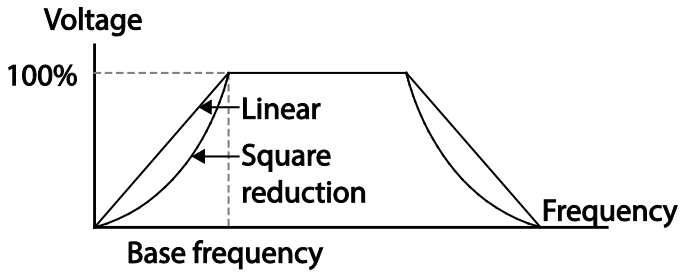
Square Reduction V/F pattern Operation

Square reduction V/F pattern is ideal for loads such as fans and pumps. It provides non–linear acceleration and deceleration patterns to sustain torque throughout the whole frequency range.

Pr. Group	Pr. Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
bA	07	V/F pattern	V/F Pattern	1	Square	0–3	–
				3	Square2		

Square Reduction V/F pattern Operation – Setting Details

Pr. Code	Description		
bA.7 V/F Pattern	Sets the parameter value to 1(Square) or 3(Square2) according to the load's start characteristics.		
	Setting		Function
	1	Square	The drive produces output voltage proportional to 1.5 square of the operation frequency.
	3	Square2	The drive produces output voltage proportional to 2 square of the operation frequency. This setup is ideal for variable torque loads such as fans or pumps.



User V/F Pattern Operation

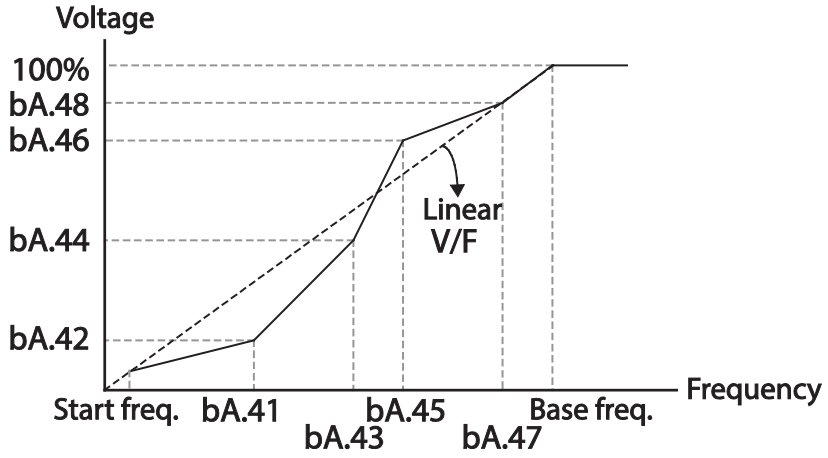
The ACN drive allows the configuration of user–defined V/F patterns to suit the load characteristics of special motors.

Pr. Group	Pr. Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
bA	07	V/F pattern	V/F Pattern	2	User V/F	0–3	–
	41	User Frequency1	User Freq 1	15.00		0–Maximum frequency	Hz
	42	User Voltage1	User Volt 1	25		0–100	%
	43	User Frequency2	User Freq 2	30.00		0–Maximum frequency	Hz
	44	User Voltage2	User Volt 2	50		0–100	%
	45	User Frequency3	User Freq 3	45.00		0–Maximum frequency	Hz
	46	User Voltage3	User Volt 3	75		0–100	%
	47	User Frequency4	User Freq 4	Maximum frequency		0–Maximum frequency	Hz
	48	User Voltage4	User Volt 4	100		0–100%	%

User V/F pattern Setting Details

Pr. Code	Description
bA.41 User Freq 1– bA.48 User Volt 4	Set the parameter values to assign arbitrary frequencies (User Freq 1–4) for start and maximum frequencies. Voltages can also be set to correspond with each frequency, and for each user voltage (User Volt 1–4).

The 100% output voltage in the figure below is based on the parameter settings of bA.15 (motor rated voltage). If bA.15 is set to 0 it will be based on the input voltage.

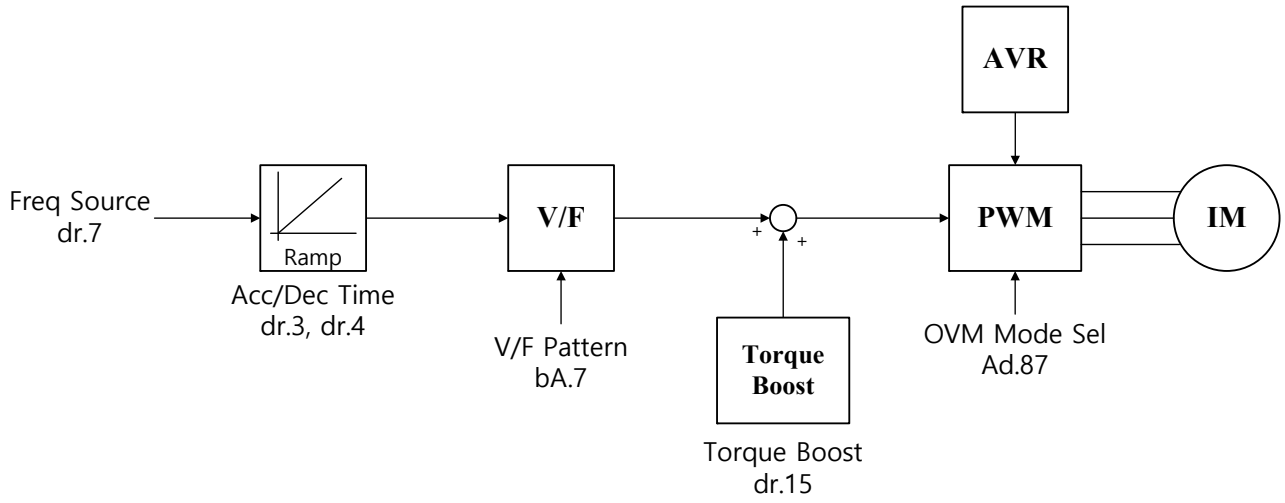


CAUTION: When a normal induction motor is in use, care must be taken not to configure the output pattern away from a linear V/F pattern. Non–linear V/F patterns may cause insufficient motor torque or motor overheating due to over–excitation.
When a user V/F pattern is in use, forward torque boost (dr.16) and reverse torque boost (dr.17) do not operate.

V/F Control Block Diagram

IM V/F Control (IMVF)

When dr.9 is set to 0: VF, the V/F control diagram is as shown here:



Torque Boost

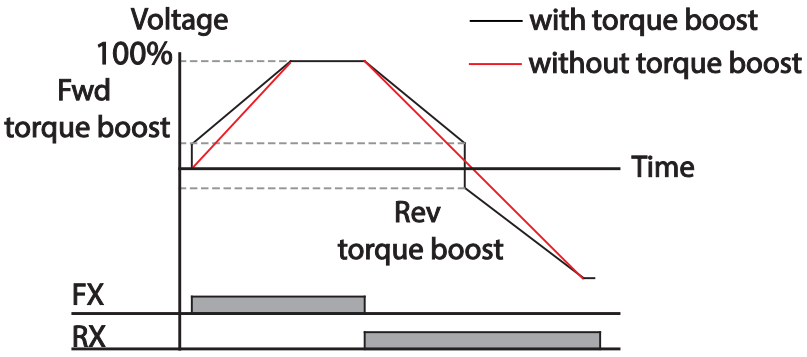
Manual Torque Boost

Manual torque boost enables users to adjust output voltage during low speed operation or motor start. Increase low speed torque or improve motor starting properties by manually increasing output voltage. Configure manual torque boost while running loads that require high starting torque, such as lift–type loads.

Pr. Group	Pr. Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
dr	15	Torque boost options	Torque Boost	0	Manual	0–1	–
	16	Forward torque boost	Fwd Boost	2.0		0.0–15.0	%
	17	Reverse torque boost	Rev Boost	2.0		0.0–15.0	%

Manual Torque Boost Setting Details

Pr. Code	Description
dr.16 Fwd Boost	Set torque boost for forward operation.
dr.17 Rev Boost	Set torque boost for reverse operation.



CAUTION: Excessive torque boost will result in over–excitation and motor overheating

Auto Torque Boost–1

Auto torque boost enables the drive to automatically calculate the amount of output voltage required for torque boost based on the entered motor parameters. Because auto torque boost requires motor–related parameters such as stator resistance, inductance, and no–load current, auto tuning (bA.20) has to be performed before auto torque boost can be configured ("Auto Tuning" on page 4–146). Similarly to manual torque boost, configure auto torque boost while running a load that requires high starting torque, such as lift–type loads.

Pr. Group	Pr. Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
dr	15	Torque boost mode	Torque Boost	1	Auto1	0–2	–
bA	20	Auto tuning	Auto Tuning	3	Rs+Lsigma	0–6	–

Auto Torque Boost–2

In V/F operation, this adjusts the output voltage if operation is unavailable due to a low output voltage. It is used when operation is unavailable, due to a lack of starting torque, by providing a voltage boost to the output voltage via the torque current.

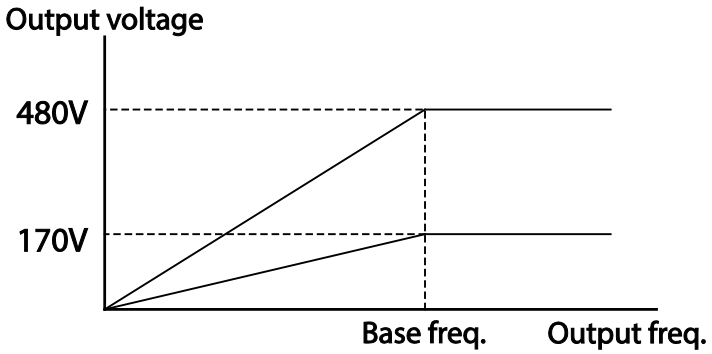
Pr. Group	Pr. Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
dr	15	Torque boost mode	Torque Boost	2	Auto2	0–2	–

Output Voltage Setting

Output voltage settings are required when a motor's rated voltage differs from the input voltage to the drive. Set bA.15 to configure the motor's rated operating voltage. The set voltage becomes the output voltage of the drive's base frequency. When the drive operates above the base frequency, and when the motor's voltage rating is lower than the input voltage at the drive, the drive adjusts the voltage and supplies the motor with the voltage set at bA.15 (motor rated voltage). If the motor's rated voltage is higher than the input voltage at the drive, the drive will supply the drive input voltage to the motor.

If bA.15 (motor rated voltage) is set to 0, the drive corrects the output voltage based on the input voltage in the stopped condition. If the frequency is higher than the base frequency, when the input voltage is lower than the parameter setting, the input voltage will be the drive output voltage.

Pr. Group	Pr. Code	Name	LCD Display	Parameter Setting	Setting Range	Unit
bA	15	Motor rated voltage	Rated Volt	0	0, 170–480	V



Start Mode Setting

Select the start mode to use when the operation command is input with the motor in the stopped condition.

Acceleration Start

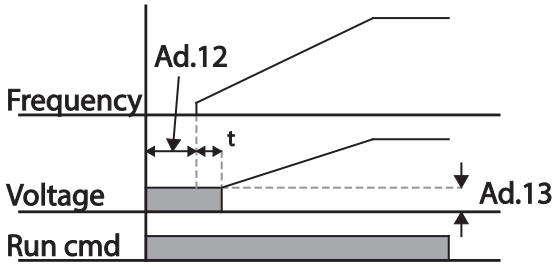
Acceleration start is a general acceleration mode. If there are no extra settings applied, the motor accelerates directly to the frequency reference when the command is input.

Pr. Group	Pr. Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
Ad	07	Start mode	Start mode	0	Acc	0–1	–

Start After DC Braking

This start mode supplies a DC voltage for a set amount of time to provide DC braking before the drive starts to accelerate a motor. If the motor continues to rotate due to its inertia, DC braking will stop the motor, allowing the motor to accelerate from a stopped condition. DC braking can also be used with a mechanical brake connected to a motor shaft when a constant torque load is applied, if a constant torque is required after the mechanical brake is released.

Pr. Group	Pr. Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
Ad	07	Start mode	Start Mode	1	DC–Start	0–1	–
	12	Start DC braking time	DC–Start Time	0.00		0.00–60.00	sec
	13	DC Injection Level	DC Inj Level	50		0–200	%



CAUTION: The amount of DC braking required is based on the motor's rated current. Do not use DC braking resistance values that can cause current draw to exceed the rated current of the drive. If the DC braking resistance is too high or brake time is too long, the motor may overheat or be damaged.

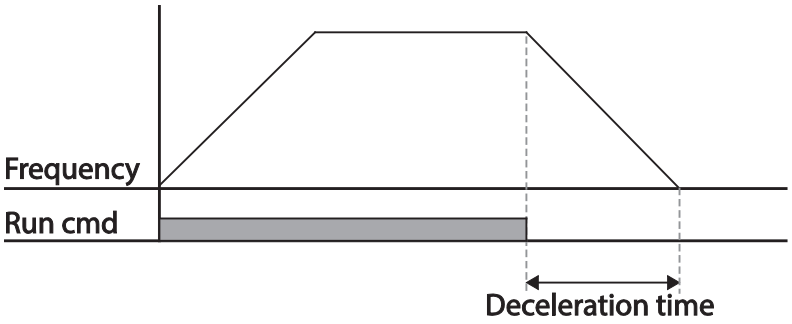
Stop Mode Setting

Select a stop mode to stop the drive operation.

Deceleration Stop

Deceleration stop is a general stop mode. If there are no extra settings applied, the motor decelerates down to 0Hz and stops, as shown in the figure below.

Pr. Group	Pr. Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
Ad	08	Stop mode	Stop Mode	0	Dec	0–4	–



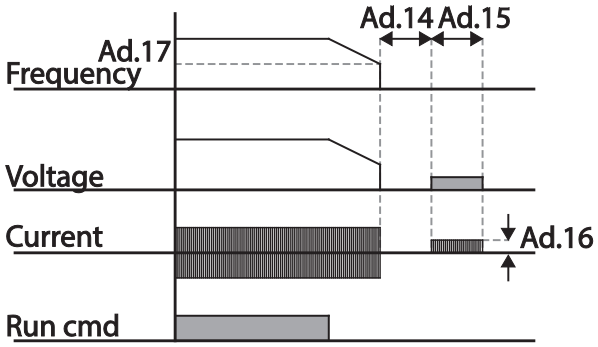
Stop After DC Braking

When the operation frequency reaches the set value during deceleration (DC braking frequency), the drive stops the motor by supplying DC power to the motor. With a stop command input, the drive begins decelerating the motor. When the frequency reaches the DC braking frequency set at Ad.17, the drive supplies DC voltage to the motor and stops it.

Pr. Group	Pr. Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
Ad	08	Stop mode	Stop Mode	0	Dec	0–4	–
	14	Output block time before braking	DC–Block Time	0.10		0.00–60.00	sec
	15	DC braking time	DC–Brake Time	1.00		0–60	sec
	16	DC braking amount	DC–Brake Level	50		0–200	%
	17	DC braking frequency	DC–Brake Freq	5.00		0.00–60.00	Hz

DC Braking After Stop Setting Details

Pr. Code	Description
Ad.14 DC–Block Time	Set the time to block the drive output before DC braking. If the inertia of the load is great, or if DC braking frequency (Ad.17) is set too high, a fault trip may occur due to overcurrent conditions when the drive supplies DC voltage to the motor. Prevent overcurrent fault trips by adjusting the output block time before DC braking.
Ad.15 DC–Brake Time	Set the time duration for the DC voltage supply to the motor.
Ad.16 DC–Brake Level	Set the amount of DC braking to apply. The parameter setting is based on the rated current of the motor.
Ad.17 DC–Brake Freq	Set the frequency to start DC braking. When the frequency is reached, the drive starts deceleration. If the dwell frequency is set lower than the DC braking frequency, dwell operation will not work and DC braking will start instead.

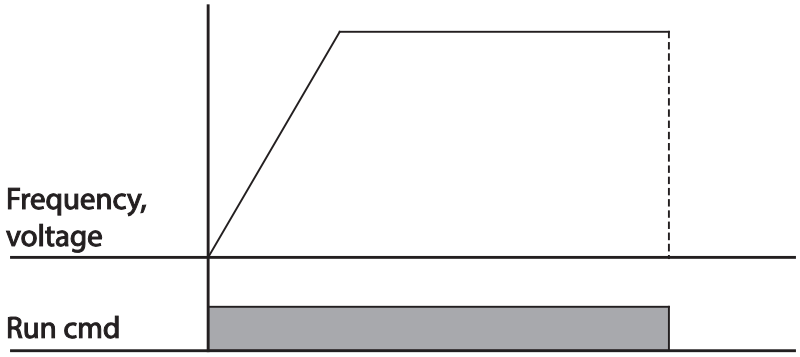


CAUTION: Note that the motor can overheat or be damaged if excessive amount of DC braking is applied to the motor, or DC braking time is set too long.
DC braking is configured based on the motor's rated current. To prevent overheating or damaging motors, do not set the current value higher than the drive's rated current.

Free Run Stop

When the Operation command is off, the drive output turns off, and the load stops due to residual inertia.

Pr. Group	Pr. Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
Ad	08	Stop Method	Stop Mode	2	Free–Run	0–4	–



CAUTION: Note that when there is high inertia on the output side and the motor is operating at high speed, the load's inertia will cause the motor to continue rotating even if the drive output is blocked.

Power Braking

When the drive's DC voltage rises above a specified level due to motor regenerated energy, a control is made to either adjust the deceleration gradient level or reaccelerate the motor in order to reduce the regenerated energy. Power braking can be used when short deceleration times are needed without brake resistors, or when optimum deceleration is needed without causing an over voltage fault trip.

Pr. Group	Pr. Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
Ad	08	Stop mode	Stop Mode	4	Power Braking	0–4	–

CAUTION:

- *To prevent overheating or damaging the motor, do not apply power braking to the loads that require frequent deceleration.*
- *Stall prevention and power braking only operate during deceleration, and power braking takes priority over stall prevention. In other words, when both Pr.50 (stall prevention and flux braking) and Ad.8 (power braking) are set, power braking will take precedence and operate.*
- *Note that if deceleration time is too short or inertia of the load is too great, an overvoltage fault trip may occur.*
- *Note that if a free run stop is used, the actual deceleration time can be longer than the pre–set deceleration time.*

Frequency Limit

Operation frequency can be limited by setting maximum frequency, start frequency, upper limit frequency and lower limit frequency.

Frequency Limit Using Maximum Frequency and Start Frequency

Pr. Group	Pr. Code	Name	LCD Display	Parameter Setting	Setting Range	Unit
dr	19	Start frequency	Start Freq	0.50	0.01–10.00	Hz
	20	Maximum frequency	Max Freq	60.00	40.00–400.00	Hz

Frequency Limit Using Maximum Frequency and Start Frequency – Setting Details

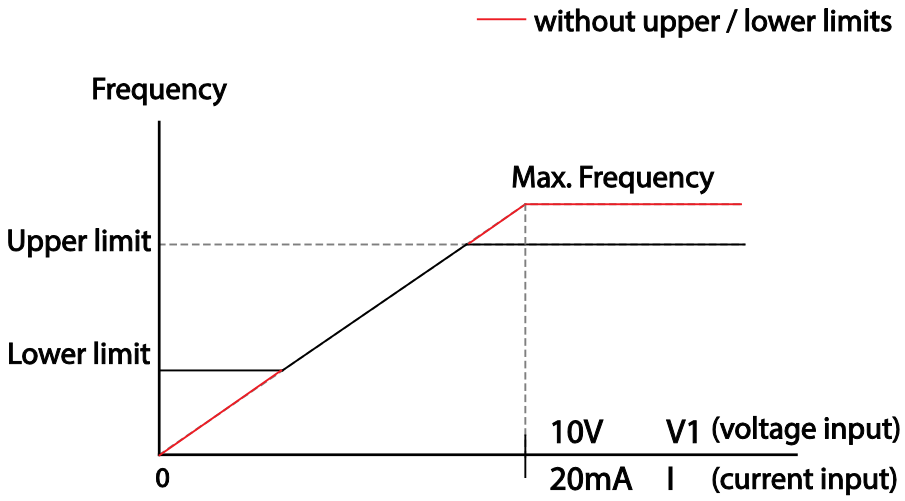
Pr. Code	Description
dr.19 Start Freq	Set the lower limit value for speed unit parameters that are expressed in Hz or rpm. If an input frequency is lower than the start frequency, the parameter value will be 0.00.
dr.20 Max Freq	Set an upper limit frequency to all speed unit parameters that are expressed in Hz or rpm, except for the base frequency (dr.18). Frequency cannot be set higher than the upper limit frequency.

Frequency Limit Using Upper and Lower Limit Frequency Values

Pr. Group	Pr. Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
Ad	24	Frequency limit	Freq Limit	0	No	0–1	–
	25	Frequency lower limit value	Freq Limit Lo	0.50		0.0–maximum frequency	Hz
	26	Frequency upper limit value	Freq Limit Hi	Maximum frequency		minimum–maximum frequency	Hz

Frequency Limit Using Upper and Lower Limit Frequencies – Setting Details

Pr. Code	Description
Ad.24 Freq Limit	The initial setting is 0(No). Changing the setting to 1(Yes) allows the setting of frequencies between the lower limit frequency (Ad.25) and the upper limit frequency (Ad.26). When the setting is 0(No), codes Ad.25 and Ad.26 are not visible.
Ad.25 Freq Limit Lo, Ad.26 Freq Limit Hi	Set upper and lower frequency limits. All frequency selections are restricted to frequencies from within the upper and lower limits. This restriction also applies when you in input a frequency reference using the keypad.

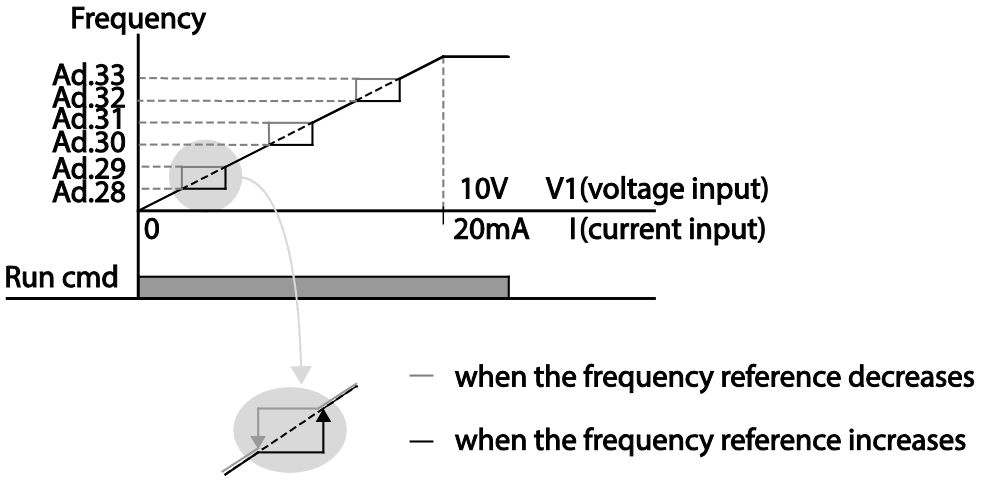


Frequency Jump

Use frequency jump to avoid mechanical resonance frequencies. Jump through frequency bands when a motor accelerates and decelerates. Operation frequencies cannot be set within the pre–set frequency jump band.

When a frequency setting is increased, while the frequency parameter setting value (voltage, current, RS–485 communication, keypad setting, etc.) is within a jump frequency band, the frequency will be maintained at the lower limit value of the frequency band. Then, the frequency will increase when the frequency parameter setting exceeds the range of frequencies used by the frequency jump band.

Pr. Group	Pr. Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
Ad	27	Frequency jump	Jump Freq	0	No	0–1	–
	28	Jump frequency lower limit1	Jump Lo 1	10.00		0.00–Jump frequency upper limit 1	Hz
	29	Jump frequency upper limit1	Jump Hi 1	15.00		Jump frequency lower limit 1–Maximum frequency	Hz
	30	Jump frequency lower limit 2	Jump Lo 2	20.00		0.00–Jump frequency upper limit 2	Hz
	31	Jump frequency upper limit 2	Jump Hi 2	25.00		Jump frequency lower limit 2–Maximum frequency	Hz
	32	Jump frequency lower limit 3	Jump Lo 3	30.00		0.00–Jump frequency upper limit 3	Hz
	33	Jump frequency upper limit 3	Jump Hi 3	35.00		Jump frequency lower limit 3–Maximum frequency	Hz



2nd Operation Mode Setting

Apply two types of operation modes and switch between them as required. For both the first and second command source, set the frequency after shifting operation commands to the multi–function input terminal. Mode switching can be used to stop remote control during an operation using the communication option and to switch operation mode to operate via the local panel, or to operate the drive from another remote control location.

Select one of the multi–function terminals from codes In. 65–69 and set the parameter value to 15 (2nd Source).

Pr. Group	Pr. Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
Operation	drv	Command source	Cmd Source*	1	Fx/Rx–1 (Fwd Run/Rev Run)	0–5	–
	Frq	Frequency reference source	Freq Ref Src	2	V1	0–12	–
bA	04	2nd Command source	Cmd 2nd Src	0	Keypad	0–4	–
	05	2nd Frequency reference source	Freq 2nd Src	0	Keypad–1	0–12	–
In	65–69	Px terminal configuration	Px Define (Px: P1–P5)	15	2nd Source	0–54	–

Displayed under DRV–06 in an LCD keypad.

2nd Operation Mode Setting Details

Pr. Code	Description
bA.4 Cmd 2nd Src ***bA.5 Freq 2nd Src***	If signals are provided to the multi–function terminal set as the 2nd command source (2nd Source), the operation can be performed using the set values from bA.4–05 instead of the set values from the drv and Frq codes in the Operation group. The 2nd command source settings cannot be changed while operating with the 1st command source (Main Source).

CAUTION:

- *When setting the multi–function terminal to the 2nd command source (2nd Source) and input (On) the signal, operation state is changed because the frequency setting and the Operation command will be changed to the 2nd command. Before shifting input to the multi–function terminal, ensure that the 2nd command is correctly set. Note that if the deceleration time is too short or inertia of the load is too high, an overvoltage fault trip may occur.*
- *Depending on the parameter settings, the drive may stop operating when you switch the command modes.*

Multi–function Input Terminal Control

Filter time constants and the type of multi–function input terminals can be configured to improve the response of input terminals

Pr. Group	Pr. Code	Name	LCD Display	Parameter Setting	Setting Range	Unit
In	85	Multi–function input terminal On filter	DI On Delay	10	0–10000	ms
	86	Multi–function input terminal Off filter	DI Off Delay	3	0–10000	ms
	87	Multi–function input terminal selection	DI NC/NO Sel	0 0000*	–	–
	90	Multi–function input terminal status	DI Status	0 0000*	–	–

See "Bit Selection" on page 4–3 for details

Multi–function Input Terminal Control Setting Details

Pr. Code	Description
In.84 DI Delay Sel	Select whether or not to activate the time values set at In.85 and In.86. If deactivated, the time values are set to the default values at In.85 and In.86. If activated, the set time values at In.85 and In.86 are set to the corresponding terminals. See "Bit Selection" on page 4–3 for details
In.85 DI On Delay, In.86 DI Off Delay	If the input terminal's state is not changed during the set time, when the terminal receives an input, it is recognized as On or Off.
In.87 DI NC/NO Sel	Select terminal contact types for each input terminal. The position of the indicator light corresponds to the segment that is on as shown in the table below. With the bottom segment on, it indicates that the terminal is configured as a A terminal (Normally Open) contact. With the top segment on, it indicates that the terminal is configured as a B terminal (Normally Closed) contact. Terminals are numbered P1–P5, from right to left. See "Bit Selection" on page 4–3 for details
In.90 DI Status	Display the configuration of each contact. When a segment is configured as Normally Open (A) terminal using In.87, the On condition is indicated by the top segment turning on. The Off condition is indicated when the bottom segment is turned on. When contacts are configured as Normally Closed (B) terminals, the segment lights behave conversely. Terminals are numbered P1–P5, from right to left. See "Bit Selection" on page 4–3 for details. If using Extension IO card, use the Left arrow key on the keypad to display the status of P8, P9 and P10.

P2P Setting

The P2P function is used to share input and output devices between multiple drives. To enable P2P setting, RS–485 communication must be turned on.

Drives connected through P2P communication are designated as either a master or slaves. The Master drive controls the input and output of slave drives. Slave drives provide input and output actions. When using the multi–function output, a slave drive can select to use either the master drive's output or its own output. When using P2P communication, first designate the slave drive and then the master drive. If the master drive is designated first, connected drives may interpret the condition as a loss of communication.

Master Parameter

Pr. Group	Pr. Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
CM	95	P2P Communication selection	Int 485 Func	1	P2P Master	0–3	–
US	80	Analog input1	P2P In V1	0		0–12, 000	%
	81	Analog input2	P2P In I2	0		–12, 000–12, 000	%
	82	Digital input	P2P In DI	0		0–0x7F	bit
	85	Analog output	P2P Out AO1	0		0–10, 000	%
	88	Digital output	P2P Out DO	0		0–0x03	bit

Slave Parameter

Pr. Group	Pr. Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
CM	95	P2P Communication selection	Int 485 Func	2	P2P Slave	0–3	–
	96	DO setting (P2P Out) selection	P2P OUT Sel	0	No	0–2	bit

P2P Setting Details

Pr. Code	Description
CM.95 Int 485 Func	Set master drive to 1(P2P Master), slave drive to 2(P2P Slave).
US.80–82 P2P Input Data	Input data sent from the slave drive.
US.85, 88 P2P Output Data	Output data transmitted to the slave drive.

CAUTION: Set the user sequence functions to use P2P features.

Multi–keypad Setting

Use multi–keypad settings to control more than one drive with one keypad. To use this function, first configure RS–485 communication.

The group of drives to be controlled by the keypad will include a master drive. The master drive monitors the other drives, and slave drive responds to the master drive's input. When using multi–function output, a slave drive can select to use either the master drive's output or its own output. When using the multi keypad, first designate the slave drive and then the master drive. If the master drive is designated first, connected drives may interpret the condition as a loss of communication.

Master Parameter

Pr. Group	Pr. Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
CM	95	P2P Communication selection	Int 485 Func	3	KPD–Ready	0–3	–
CNF	03	Multi–keypad ID	Multi KPD ID	3		3–99	–
	42	Multi–function key selection	Multi Key Sel	4	Multi KPD	0–4	–

Slave Parameter

Pr. Group	Pr. Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
CM	01	Station ID	Int485 St ID	3		3–99	–
	95	P2P communication options	Int 485 Func	3	KPD–Ready	0–3	–

Multi–keypad Setting Details

Pr. Code	Description
CM.01 Int485 St ID	Prevents conflict by designating a unique identification value to an drive. Values can be selected from numbers between 3–99.
CM.95 Int 485 Func	Set the value to 3(KPD–Ready) for both master and slave drive
CNF.03 Multi KPD ID	Select an drive to monitor from the group of drives.
CNF.42 Multi key Sel	Select a multi–function key type 4(Multi KPD)

CAUTION:

- *The multi–keypad feature will not work when the multi–keypad ID (CNF.03 Multi–KPD ID) setting is identical to the RS–485 communication station ID (CM.1 Int485 st ID) setting.*
- *The master/slave setting cannot be changed while the drive is operating in slave mode.*

User Sequence Setting

User Sequence allows custom programming to provide advanced control of the ACN series drive and the surrounding equipment. It can be used to provide simple diagnostics such as counting the number of times an input is received, or for more advanced control such as command frequency changes based on timers or other conditions. User Sequence creates a simple sequence from a combination of different function blocks. The sequence can comprise of a maximum of 18 steps using 29 function blocks and 30 void parameters.

User sequence can be programmed in 2 ways:

1) **Drive Keypad**: Entering the values in each parameter via the drive keypad.

2) **Using VFD Suite software**: See Chapter 7 for more information on User Sequence Windows based programming.

1 Loop refers to a single execution of a user configured sequence that contains a maximum of 18 steps. Users can select a Loop Time of between 10–1,000ms.

The codes for user sequences configuration can be found in the US group (for user sequence settings) and the UF group (for function block settings).

Pr. Group	Pr. Code	Name	LCD Display	Parameter Setting	Setting Range	Unit
AP	02	User sequence activation	User Seq En	0	0–1	–
US	01	User sequence operation command	User Seq Con	0	0–2	–
	02	User sequence operation time	User Loop Time	0	0–5	–
	11–28	Output address link1–18	Link UserOut1–18	0	0–0xFFFF	–
	31–60	Input value setting1–30	Void Para1–30	0	–9999–9999	–
	80	Analog input 1	P2P In V1(–10–10 V)	0	0–12, 000	%
	81	Analog input 2	P2P In I2	0	–12, 000	%
	82	Digital input	P2P In D	0	–12, 000	bit
	85	Analog output	P2P Out AO1	0	0–0x7F	%
	89	Digital output	P2P Out DO	0	0–0x03	bit

Pr. Group	Pr. Code	Name	LCD Display	Parameter Setting	Setting Range	Unit
UF	01	User function 1	User Func1	0	0–28	–
	02	User function input 1–A	User Input 1–A	0	0–0xFFFF	–
	03	User function input 1–B	User Input 1–B	0	0–0xFFFF	–
	04	User function input 1–C	User Input 1–C	0	0–0xFFFF	–
	05	User function output 1	User Output 1	0	–32767–32767	–
	06	User function 2	User Func2	0	0–28	–
	07	User function input 2–A	User Input 2–A	0	0–0xFFFF	–
	08	User function input 2–B	User Input 2–B	0	0–0xFFFF	–
	09	User function input 2–C	User Input 2–C	0	0–0xFFFF	–
	10	User function output 2	User Output 2	0	–32767–32767	–
	11	User function 3	User Func3	0	0–28	–
	12	User function input 3–A	User Input 3–A	0	0–0xFFFF	–
	13	User function input 3–B	User Input 3–B	0	0–0xFFFF	–
	14	User function input 3–C	User Input 3–C	0	0–0xFFFF	–
	15	User function output 3	User Output 3	0	–32767–32767	–
	16	User function 4	User Func4	0	0–28	–
	17	User function input 4–A	User Input 4–A	0	0–0xFFFF	–
	18	User function input 4–B	User Input 4–B	0	0–0xFFFF	–

Pr. Group	Pr. Code	Name	LCD Display	Parameter Setting	Setting Range	Unit
UF	19	User function input 4–C	User Input 4–C	0	0–0xFFFF	–
	20	User function output 4	User Output 4	0	–32767–32767	–
	21	User function 5	User Func5	0	0–28	–
	22	User function input 5–A	User Input 5–A	0	0–0xFFFF	–
	23	User function input 5–B	User Input 5–B	0	0–0xFFFF	–
	24	User function input 5–C	User Input 5–C	0	0–0xFFFF	–
	25	User function output 5	User Output 5	0	–32767–32767	–
	26	User function 6	User Func6	0	0–28	–
	27	User function input 6–A	User Input 6–A	0	0–0xFFFF	–
	28	User function input 6–B	User Input 6–B	0	0–0xFFFF	–
	29	User function input 6–C	User Input 6–C	0	0–0xFFFF	–
	30	User function output 6	User Output 6	0	–32767–32767	–
	31	User function 7	User Func7	0	0–28	–
	32	User function input 7–A	User Input 7–A	0	0–0xFFFF	–
	33	User function input 7–B	User Input 7–B	0	0–0xFFFF	–
	34	User function input 7–C	User Input 7–C	0	0–0xFFFF	–
	35	User function output 7	User Output 7	0	–32767–32767	–
	36	User function 8	User Func8	0	0–28	–
	37	User function input 8–A	User Input 8–A	0	0–0xFFFF	–
	38	User function input8–B	User Input 8–B	0	0–0xFFFF	–
	39	User function input 8–C	User Input 8–C	0	0–0xFFFF	–
	40	User function output 8	User Output 8	0	–32767–32767	–
	41	User function 9	User Func9	0	0–28	–
	42	User function input 9–A	User Input 9–A	0	0–0xFFFF	–
	43	User function input 9–B	User Input 9–B	0	0–0xFFFF	–
	44	User function input 9–C	User Input 9–C	0	0–0xFFFF	–
	45	User function output 9	User Output 9	0	–32767–32767	–
	46	User function 10	User Func10	0	0–28	–
	47	User function input 10–A	User Input 10–A	0	0–0xFFFF	–
	48	User function input 10–B	User Input 10–B	0	0–0xFFFF	–
	49	User function input 10–C	User Input 10–C	0	0–0xFFFF	–
	50	User function output 10	User Output 10	0	–32767–32767	–
	51	User function 11	User Func11	0	0–28	–
	52	User function input 11–A	User Input 11–A	0	0–0xFFFF	–
	53	User function input 11–B	User Input 11–B	0	0–0xFFFF	–
	54	User function input 11–C	User Input 11–C	0	0–0xFFFF	–
	55	User function output 11	User Output 11	0	–32767–32767	–
	56	User function 12	User Func12	0	0–28	–
	57	User function input 12–A	User Input 12–A	0	0–0xFFFF	–
	58	User function input 12–B	User Input 12–B	0	0–0xFFFF	–
	59	User function input 12–C	User Input 12–C	0	0–0xFFFF	–
	60	User function output 12	User Output 12	0	–32767–32767	–
	61	User function 13	User Func13	0	0–28	–
	62	User function input 13–A	User Input 13–A	0	0–0xFFFF	–

Pr. Group	Pr. Code	Name	LCD Display	Parameter Setting	Setting Range	Unit
UF	63	User function input 13–B	User Input 13–B	0	0–0xFFFF	–
	64	User function input 13–C	User Input 13–C	0	0–0xFFFF	–
	65	User function output 13	User Output 13	0	–32767–32767	–
	66	User function 14	User Func14	0	0–28	–
	67	User function input 14–A	User Input 14–A	0	0–0xFFFF	–
	68	User function input14–B	User Input 14–B	0	0–0xFFFF	–
	69	User function input 14–C	User Input 14–C	0	0–0xFFFF	–
	70	User function output14	User Output 14	0	–32767–32767	–
	71	User function 15	User Func15	0	0–28	–
	72	User function input 15–A	User Input 15–A	0	0–0xFFFF	–
	73	User function input 15–B	User Input 15–B	0	0–0xFFFF	–
	74	User function input 15–C	User Input 15–C	0	0–0xFFFF	–
	75	User function output 15	User Output 15	0	–32767–32767	–
	76	User function 16	User Func16	0	0–28	–
	77	User function input 16–A	User Input 16–A	0	0–0xFFFF	–
	78	User function input 16–B	User Input 16–B	0	0–0xFFFF	–
	79	User function input 16–C	User Input 16–C	0	0–0xFFFF	–
	80	User function output 16	User Output 16	0	–32767–32767	–
	81	User function 17	User Func17	0	0–28	–
	82	User function input 17–A	User Input 17–A	0	0–0xFFFF	–
	83	User function input 17–B	User Input 17–B	0	0–0xFFFF	–
	84	User function input 17–C	User Input 17–C	0	0–0xFFFF	–
	85	User function output 17	User Output 17	0	–32767–32767	–
	86	User function 18	User Func18	0	0–28	–
	87	User function input 18–A	User Input 18–A	0	0–0xFFFF	–
	88	User function input 18–B	User Input 18–B	0	0–0xFFFF	–
	89	User function input 18–C	User Input 18–C	0	0–0xFFFF	–
	90	User function output 18	User Output 18	0	–32767–32767	–

User Sequence Setting Details

Pr. Code	Description
AP.2 User Seq En	Set AP.2 = 1 to enable the user sequence. This allows parameter groups US and UF to be displayed for programming.
US.1 User Seq Con	Controls the the User sequence run and stop mode. 0= Stop 1= Run 2= Digital Input Run- (status of digital input determines program run or stop). Digital input must be set to 5=UserSeq) To program and adjust the user sequence, this parameter must be set to 0 (Stop)

Pr. Code	Description
US.2 User Loop Time	The user sequence loop time determines the time interval that the user sequence programming will be executed. User sequence loop time can be set as follows: 0= 0.01s 1= 0.02s 2= 0.05s 3 =0.1s 4 =0.5s 5 =1s
US.11–28 Link UserOut1–18	Set parameters to connect 18 Function Blocks. If the input value is 0x0000, an output value cannot be used. To use the output value in step 1 for the frequency reference (Cmd Frequency), input the communication address(0x1101) of the Cmd frequency as the Link UserOut1 parameter.
US.31–60 Void Para1–30	Set 30 void parameters. Use when a constant value parameter input is needed in the user function block.
UF.1–90	Set user defined functions for the 18 function blocks. If the function block setting is invalid, the output of the User Output@ is –1. All the outputs from the User Output@ are read only, and can be used with the user output link@ (Link UserOut@) of the US group.

Programming

- *User sequence is composed of function blocks and links.*
- *One or more values are inputted into a function block, the function block completes the preset operation, and then outputs a value.*
- *Inputs of function block can be linked by inputting communication addresses of parameters or constant values.*
- *Output Links determine where to output the result of the operation. Outputs can be used as input of other function blocks.*
- *Function block can be used many times in one loop.*

Programming Rules

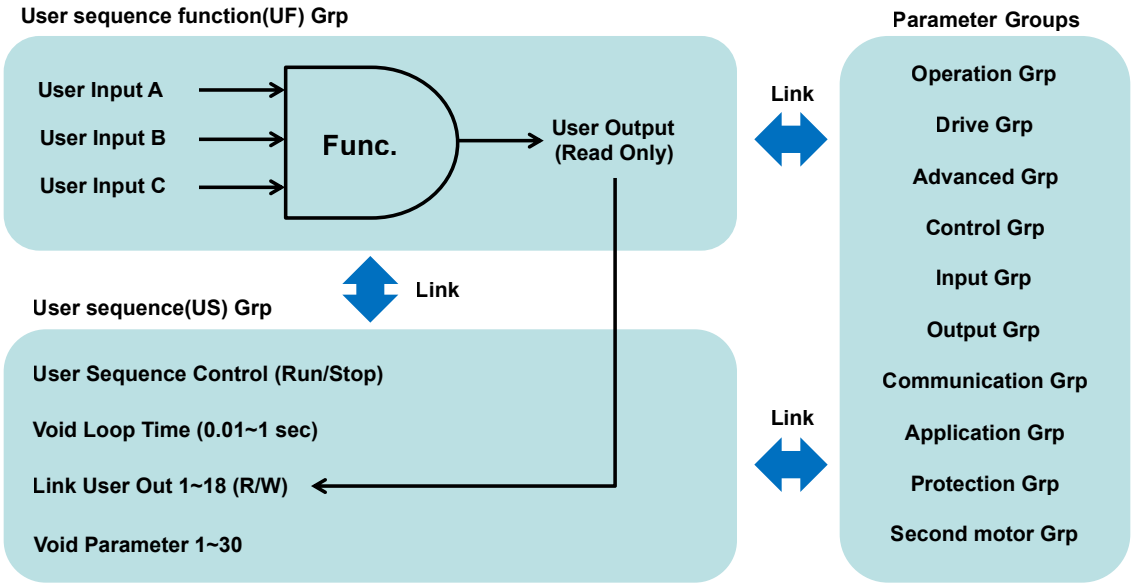
- *Parameters cannot be adjusted during User Sequence Run Mode (Ap.2). To adjust parameters, the operation must be stopped.*
- *All the outputs from the User Output@ are read only, and can be used with the user output link@(Link UserOut@) of the USS group.*
- *Function blocks can be used many times in one loop.*
- *Set parameter's address at Link UserOut@ to connect 18 function blocks. If the input value is 0x0000, an output value cannot be used.*
- *Void parameter can be set between -9999~9999.*
- *It the function block setting is invalid, the output of the User Output@ is -1*

Execution Rules

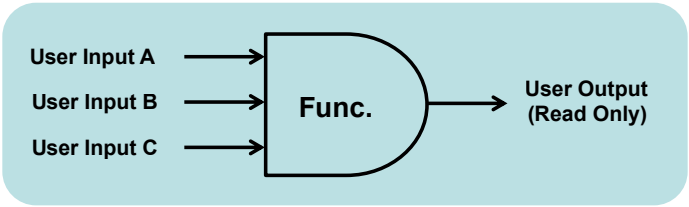
- *1 Loop refers to a single execution of a user configured sequence that contains a maximum of 18 steps.*
- *Users can select a loop time of between 10~1000ms at US.2.*
- *Output value of function block is between maximum and minimum value and can limit the output using limit function.*
- *If the scale of linked two parameter is different each other, scale is not changed automatically*

Activation

- *In order to activate the user sequence function, set AP.2 = 1.*
- *After user sequence is activated, US and UF parameter groups appear.*



Understanding of FB (Function Block)

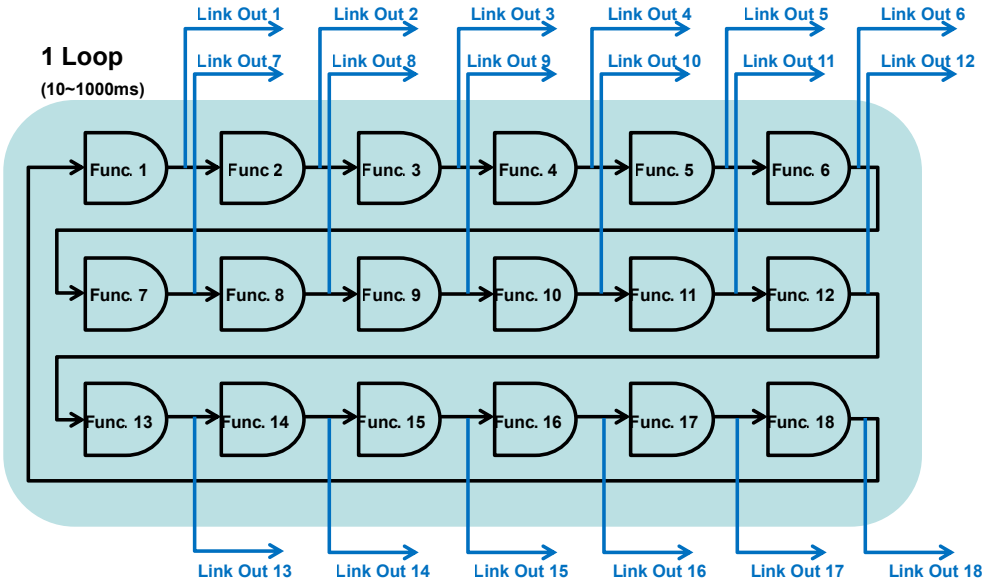


Each function block consists of 1-3 inputs and 1 output

Type	Description
User Func @*	Choose the function to perform in the function block.
User Input @-A	Communication address of the function's first input parameter.
User Input @-B	Communication address of the function's second input parameter.
User Input @-C	Communication address of the function's third input parameter.
User Output @	Output value (Read Only) after performing the function block.
@ is the step number (1–18)	

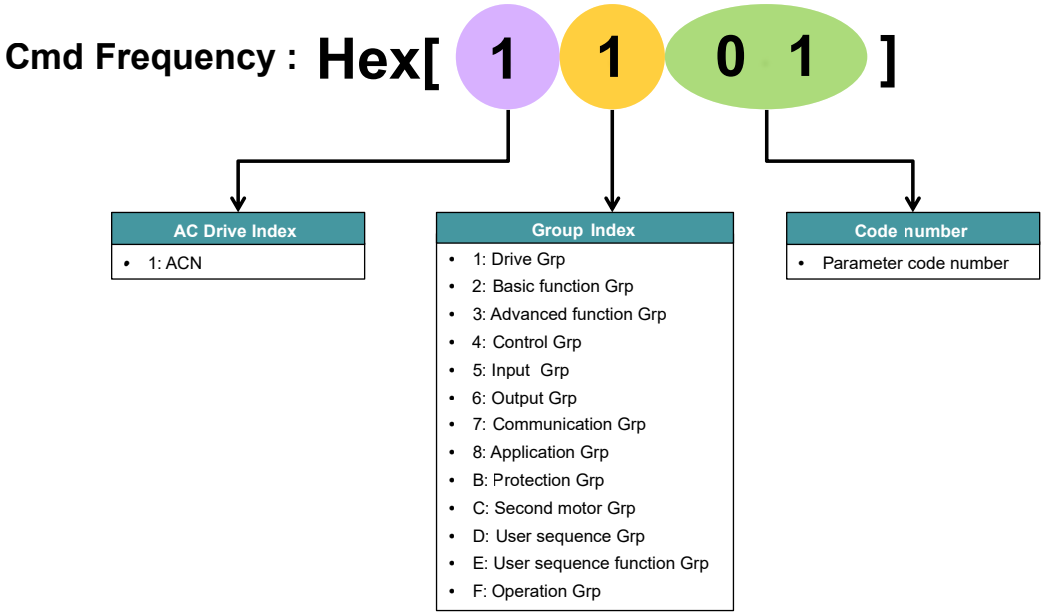
1 Loop Sequence

- *The sequence can comprise of a maximum of 18 steps using 29 function blocks and 30 void parameters.*
- *1 Loop refers to a single execution of a user configured sequence that contains a maximum of 18 steps. Users can select a loop time of between 10~1000ms.*



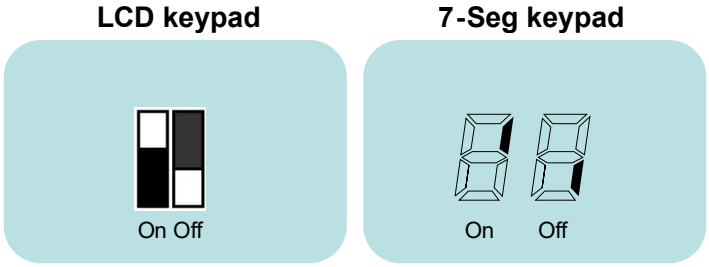
Communication Address

- *Input/Output links are connected by the communication address.*
- *Communication address is hexadecimal. The constituting principle is as follows.*

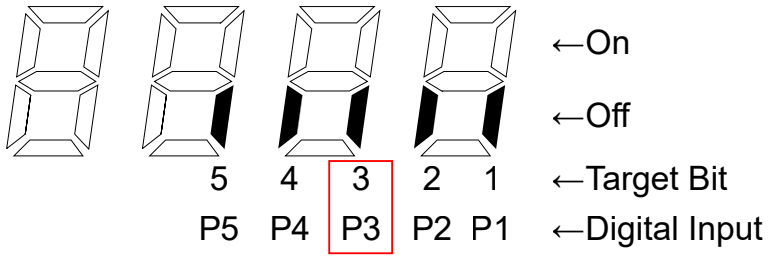


Data Format Type

- *Integer Type*
  - » *Output range is -9999~9999.*
  - » *Function block: Functions except for AND/OR/XOR/ANDOR/BITSET/BITCLEAR.*
- *Binary digit type*
  - » *This type is expressed as 0 or 1, each is Off(False) or On(True).*
  - » *To use a digital input/output individual bit in the program, the BITTEST/BITSET/BITCLEAR function block is required as the first programming step to separate the bit value from the word. See example below.*
  - » *Function block: AND/OR/XOR/ANDOR/BITSET/BITCLEAR*
  - » *Results of this type is expressed as below, There are any problem in calculating with other functions except for SWITCH function. If you input binary digit type parameters to SWITCH function, because of the error, the output is -1.*



Example: Monitor Digital Input P3 from the DI Status Word
Parameter: In.90
Comm Address: 155A



Digital Input/Output Programming Addresses

The Digital Input/Output status information can be used in function blocks for monitor and control. The following tables show the addresses for the digital I/O.

To use a digital input/output individual bit in the program, the BITTEST/BITSET/BITCLEAR function block is required as the first programming step to separate the bit value from the word. See example above.

Communication multi-functional input (0385h) control			Word Value example
Target Bit	Word Value	Description	
B16	2^{15}=32,768	Reserved	• No input = 0 • Virtual DI 1 input = 1 • Virtual DI 1+DI 2 input = 1+2 = 3 • Virtual DI 1+DI 3 input = 1+4 = 5
B15	2^{14}=16,384	Reserved	
B14	2^{13}=8,192	Reserved	
B13	2^{12}=4,096	Reserved	
B12	2^{11}=2,048	Reserved	
B11	2^{10}=1,024	Reserved	
B10	2^{9}=512	Reserved	
B9	2^{8}=256	Reserved	
B8	2^{7}=128	Virtual DI 8 (CM.77)	
B7	2^{6}=64	Virtual DI 7 (CM.76)	
B6	2^{5}=32	Virtual DI 6 (CM.75)	
B5	2^{4}=16	Virtual DI 5 (CM.74)	
B4	2^{3}=8	Virtual DI 4 (CM.73)	
B3	2^{2}=4	Virtual DI 3 (CM.72)	
B2	2^{1}=2	Virtual DI 2 (CM.71)	
B1	2^{0}=1	Virtual DI 1 (CM.70)	

Digital output(0386h) control			Word Value example
Target Bit	Word Value	Description	
B16	2^{15}=32,768	Reserved	• No output =0 • Relay1 output = 1 • Relay1+Q1 output = 1+2 = 3
B15	2^{14}=16,384	Reserved	
B14	2^{13}=8,192	Reserved	
B13	2^{12}=4,096	Reserved	
B12	2^{11}=2,048	Reserved	
B11	2^{10}=1,024	Reserved	
B10	2^{9}=512	Reserved	
B9	2^{8}=256	Reserved	
B8	2^{7}=128	Reserved	
B7	2^{6}=64	Reserved	
B6	2^{5}=32	Multi_Func Output 4(ExtIO-R4)	
B5	2^{4}=16	Multi_Func Output 3(ExtIO-R3)	
B4	2^{3}=8	Reserved	
B3	2^{2}=4	Reserved	
B2	2^{1}=2	Multi-func. output 1(Q1)	
B1	2^{0}=1	Multi-func. Relay 1(A1, B1, C1 terminals)	

Target Bit	Word Value	Description	Monitoring Word Value example
Digital Input (DI) Status, In.90(155Ah)			
B11	2^{10}=1,024	P10 terminal Setting	• No input =0 • P1 input = 1 • P1+P2 input = 1+2 = 3 • Relay1 output = 1 • Relay1+Q1 output = 1+2 = 3
B10	2^{9}=512	P9 terminal Setting	
B9	2^{8}=256	P8 terminal Setting	
B8	2^{7}=128	Reserved	
B7	2^{6}=64	Reserved	
B6	2^{5}=32	Reserved	
B5	2^{4}=16	P5 terminal Setting	
B4	2^{3}=8	P4 terminal Setting	
B3	2^{2}=4	P3 terminal Setting	
B2	2^{1}=2	P2 terminal Setting	
B1	2^{0}=1	P1 terminal Setting	
Digital Output (DO) Status, OU.41 (1629h)			
B6	2^{5}=32	Multi-Func Relay 4 (Ext IO- R3)	
B5	2^{4}=16	Multi-Func Relay 3 (Ext IO-R4)	
B4	2^{3}=8	Reserved	
B3	2^{2}=4	Reserved	
B2	2^{1}=2	Multi-functional output 1 (Q1)	
B1	2^{0}=1	Multi-functional Relay 1(A1, B1, C1 terminals)	

Operation Status Monitoring Addresses

The drive operation status information can be used in function blocks. The following table shows the addresses for monitoring. If monitoring an individual bit, the BIT TEST function block must be used. Reference the "Target Bit" column. If monitoring the full Status Word in a compare block, reference the Monitoring Value example column. Interaction between varies bits will change the value of the status word.

Operation status(000E) monitoring			Monitoring value example
Target Bit	**Word Value**	**Description**	
B16	2^{15}=32,768	0: Remote, 1: Local	• Stopped(B0)= 1 • FWD accelerating(B2+B5+B12)= 2+16+2048= 2066 • FWD decelerating(B2+B6+B12)= 2+32+2048= 2082 • FWD stopping(B2+B9)= 2+256= 258 • FWD speed reached(B2+B7+B12)= 2+64+2048= 2114
B15	2^{14}=16,384	1: Frequency command source by communication	
B14	2^{13}=8,192	1: Operation command source by communication	
B13	2^{12}=4,096	REV operation command	
B12	2^{11}=2,048	FWD operation command	
B11	2^{10}=1,024	Brake release signal	
B10	2^{9}=512	Jog mode	
B9	2^{8}=256	Stopping	
B8	2^{7}=128	DC braking	
B7	2^{6}=64	Speed reached	
B6	2^{5}=32	Decelerating	
B5	2^{4}=16	Accelerating	
B4	2^{3}=8	Fault(Trip)	
B3	2^{2}=4	Run in REV direction	
B2	2^{1}=2	Run in FWD direction	
B1	2^{0}=1	Stopped	

ACN Major parameter communication addresses

The following are common address values that are used in function block programming.

Address (Hex)	Parameter	Unit	Scale
0005	Commanded Freq	Hz	0.01
1101	Target Freq.	Hz	0.01
1103	Acc Time	Sec	0.1
1104	Dec Time	Sec	0.1
1505	Analog Input 1	%	0.01
1606	Analog Output 1	%	0.1
155A	Multi-func. Input Status	Bit	-
0385	Virtual Multi-func. Input	Bit	-
1629	Multi-func. Output Status	Bit	-
1404	Carrier Freq.	kHz	0.1
0009	Output Current	A	0.1
000A	Output Freq.	Hz	0.01
000B	Output Volt.	V	1
000C	DC-link Volt.	V	1
000D	Output Power	kW	0.1
000E	Operation Status	-	-
000F	Fault Info.	-	-

ACN User Sequence Void Constant Parameters

If a constant value is needed in any user sequence program function block, utilize the Void constant parameters Us.31- US.60. Program these addresses into function blocks with the Hex Address. Note the constant values are decimal.

ACN User Sequence Void Constant Parameters			
Address (Hex)	**Code**	**Name**	**Range (decimal)**
0h1D1F	US.31	Void constant setting1	-9999-9999
0h1D20	US.32	Void constant setting2	-9999-9999
0h1D21	US.33	Void constant setting3	-9999-9999
0h1D22	US.34	Void constant setting4	-9999-9999
0h1D23	US.35	Void constant setting5	-9999-9999
0h1D24	US.36	Void constant setting6	-9999-9999
0h1D25	US.37	Void constant setting7	-9999-9999
0h1D26	US.38	Void constant setting8	-9999-9999
0h1D27	US.39	Void constant setting9	-9999-9999
0h1D28	US.40	Void constant setting10	-9999-9999
0h1D29	US.41	Void constant setting11	-9999-9999
0h1D2A	US.42	Void constant setting12	-9999-9999
0h1D2B	US.43	Void constant setting13	-9999-9999
0h1D2C	US.44	Void constant setting14	-9999-9999
0h1D2D	US.45	Void constant setting15	-9999-9999
0h1D2E	US.46	Void constant setting16	-9999-9999
0h1D2F	US.47	Void constant setting17	-9999-9999

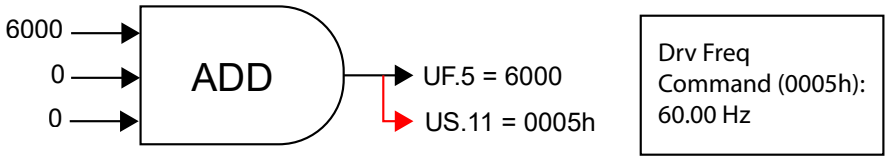
ACN User Sequence Void Constant Parameters			
Address (Hex)	**Code**	**Name**	**Range (decimal)**
0h1D30	US.48	Void constant setting18	-9999-9999
0h1D31	US.49	Void constant setting19	-9999-9999
0h1D32	US.50	Void constant setting20	-9999-9999
0h1D33	US.51	Void constant setting21	-9999-9999
0h1D34	US.52	Void constant setting22	-9999-9999
0h1D35	US.53	Void constant setting23	-9999-9999
0h1D36	US.54	Void constant setting24	-9999-9999
0h1D37	US.55	Void constant setting25	-9999-9999
0h1D38	US.56	Void constant setting26	-9999-9999
0h1D39	US.57	Void constant setting27	-9999-9999
0h1D3A	US.58	Void constant setting28	-9999-9999
0h1D3B	US.59	Void constant setting29	-9999-9999
0h1D3C	US.60	Void constant setting30	-9999-9999

ACN User Sequence Function Block Output Parameters

The output values of the 18 function blocks are read only addresses. These values can be read or monitored using the Hex address. The FB output values can be transferred to a different location by using the Output Address Link Parameters, which are linked automatically to the User Function Output value.

For example, if it is desired for the User function 1 ouput to be the Command frequency to the drive, program as follows:

Code	Address	Name	Setting
dr.7	***0h1107***	Freq Ref Source	9-Usr Seq
US.32	***0h1D20***	Void constant2	6000
US.33	***0h1D21***	Void constant3	0
UF.1	***0h1E02***	UF 1	1:ADD
UF.2	***0h1E02***	UF input 1-A	1D20h
UF.3	***0h1E03***	UF input 1-B	1D21h
UF.4	***0h1E04***	UF input 1-C	1D21h
UF.5	***0h1E05***	UF output1	-
US.11	***0h1D0B***	Output address link1	0005h



Function Block Output Addresses (Read Only)					Function Block Output Link Parameters			
Address (Hex)	Code	Name	Setting Range (Decimal)		Address (Hex)	Code	Name	Range (Hex)
0h1E05	UF.5	User function output1	-32767-32767	→	***0h1D0B***	US.11	Output address link1	0–0xFFFF
0h1E0A	UF.10	User function output2	-32767-32767	→	***0h1D0C***	US.12	Output address link2	0–0xFFFF
0h1E0F	UF.15	User function output3	-32767-32767	→	***0h1D0D***	US.13	Output address link3	0–0xFFFF
0h1E14	UF.20	User function output4	-32767-32767	→	***0h1D0E***	US.14	Output address link4	0–0xFFFF
0h1E19	UF.25	User function output5	-32767-32767	→	***0h1D0F***	US.15	Output address link5	0–0xFFFF
0h1E1E	UF.30	User function output6	-32767-32767	→	***0h1D10***	US.16	Output address link6	0–0xFFFF
0h1E23	UF.35	User function output7	-32767-32767	→	***0h1D11***	US.17	Output address link7	0–0xFFFF
0h1E28	UF.40	User function output8	-32767-32767	→	***0h1D12***	US.18	Output address link8	0–0xFFFF
0h1E2D	UF.45	User function output9	-32767-32767	→	***0h1D13***	US.19	Output address link9	0–0xFFFF
0h1E32	UF.50	User function output10	-32767-32767	→	***0h1D14***	US.20	Output address link10	0–0xFFFF
0h1E37	UF.55	User function output11	-32767-32767	→	***0h1D15***	US.21	Output address link11	0–0xFFFF
0h1E3C	UF.60	User function output12	-32767-32767	→	***0h1D16***	US.22	Output address link12	0–0xFFFF
0h1E41	UF.65	User function output13	-32767-32767	→	***0h1D17***	US.23	Output address link13	0–0xFFFF
0h1E46	UF.70	User function output14	-32767-32767	→	***0h1D18***	US.24	Output address link14	0–0xFFFF
0h1E4B	UF.75	User function output15	-32767-32767	→	***0h1D19***	US.25	Output address link15	0–0xFFFF
0h1E50	UF.80	User function output16	-32767-32767	→	***0h1D1A***	US.26	Output address link16	0–0xFFFF
0h1E55	UF.85	User function output17	-32767-32767	→	***0h1D1B***	US.27	Output address link17	0–0xFFFF
0h1E5A	UF.90	User function output18	-32767-32767	→	***0h1D1C***	US.28	Output address link18	0–0xFFFF

User Function Block Programming - Operation Explanation

The following table explains the operation of each programming block. For program examples, refer to the support resources section on the drive item page on the webstore.

Number	Type	Description
0	NOP	No Operation.
1	ADD	Addition operation, (A + B) + C If the C parameter is 0x0000, it will be recognized as 0.
2	SUB	Subtraction operation, (A – B) – C If the C parameter is 0x0000, it will be recognized as 0.
3	ADDSUB	Addition and subtraction compound operation, (A + B) – C If the C parameter is 0x0000, it will be recognized as 0.
4	MIN	Output the smallest value of the input values, MIN(A, B, C). If the C parameter is 0x0000, operate only with A, B.
5	MAX	Output the largest value of the input values, MAX(A, B, C). If the C parameter is 0x0000, operate only with A, B.
6	ABS	Output the absolute value of the A parameter, | A |. This operation does not use the B, or C parameter.
7	NEGATE	Output the negative value of the A parameter, –(A). This operation does not use the B, or C parameter.
8	REMAINDER	Remainder operation of A and B, A % B This operation does not use the C parameter.
9	MPYDIV	Multiplication, division compound operation, (A x B)/C. If the C parameter is 0x0000, output the multiplication operation of (A x B).

Number	Type	Description
10	COMPARE–GT (greater than)	Comparison operation: if (A > B) the output is C; if (A </=B) the output is 0. If the condition is met, the output parameter is C. If the condition is not met, the output is 0(False). If the C parameter is 0x0000 and if the condition is met, the output is 1(True).
11	COMPARE–GTEQ (greater than or equal to)	Comparison operation; if (A >/= B) output is C; if (A<B) the output is 0. If the condition is met, the output parameter is C. If the condition is not met, the output is 0(False). If the C parameter is 0x0000 and if the condition is met, the output is 1(True).
12	COMPARE–EQUAL	Comparison operation, if(A == B) then the output is C. For all other values the output is 0. If the condition is met, the output parameter is C. If the condition is not met, the output is 0(False). If the C parameter is 0x0000 and if the condition is met, the output is 1(True).
13	COMPARE–NEQUAL	Comparison operation, if(A != B) then the output is C. For all other values the output is 0. If the condition is met, the output parameter is C. If the condition is not met, the output is 0(False). If the C parameter is 0x0000 and if the condition is met, the output is 1(True).
14	TIMER	Adds 1 each time a user sequence completes a loop. A: Max Loop, B: Timer Run/Stop, C: Choose output mode. If input of B is 1, timer stops (output is 0). If input is 0, timer runs. If input of C is 1, output the current timer value. If input of C is 0, output 1 when timer value exceeds A(Max) value. If the C parameter is 0x0000, C will be recognized as 0. Timer overflow Initializes the timer value to 0.
15	LIMIT	Sets a limit for the A parameter. If input to A is between B and C, output the input to A. If input to A is larger than B, output B. If input of A is smaller than C, output C. B parameter must be greater than or equal to the C parameter.
16	AND	Output the AND operation, (A and B) and C. If the C parameter is 0x0000, operate only with A, B.
17	OR	Output the OR operation, (A | B) | C. If the C parameter is 0x0000, operate only with A, B.
18	XOR	Output the XOR operation, (A ^ B) ^ C. If the C parameter is 0x0000, operate only with A, B.
19	AND/OR	Output the AND/OR operation, (A and B) | C. If the C parameter is 0x0000, operate only with A, B.
20	SWITCH	Output a value after selecting one of two inputs, if (A) then B otherwise C. If the input at A is 1, the output will be B. If the input at A is 0, the output parameter will be C.
21	BITTEST	Test the B bit of the A parameter, BITTEST(A, B). If the B bit of the A input is 1, the output is 1. If it is 0, then the output is 0. The input value of B must be between 0–16. If the value is higher than 16, it will be recognized as 16. If input at B is 0, the output is always 0.
22	BITSET	Set the B bit of the A parameter, BITSET(A, B). Output the changed value after setting the B bit to input at A. The input value of B must be between 0–16. If the value is higher than 16, it will be recognized as 16. If the input at B is 0, the output is always 0. This operation does not use the C parameter.
23	BITCLEAR	Clear the B bit of the A parameter, BITCLEAR(A, B). Output the changed value after clearing the B bit to input at A. The input value of B must be between 0–16. If the value is higher than 16, it will be recognized as 16. If the input at B is 0, the output is always 0. This operation does not use the C parameter.
24	LOWPASSFILTER	Output the input at A as the B filter gains time constant, B x US.2 (US Loop Time. In the above formula, set the time when the output of A reaches 63.3% C stands for the filter operation. If it is 0, the operation is started.
25	PI_CONTROL	P, I gain = A, B parameter input, then output as C. Conditions for PI_PROCESS output: C = 0: Const PI, C = 1: PI_PROCESS–B >= PI_PROCESS–OUT >= 0, C = 2: PI_PROCESS–B >= PI_PROCESS–OUT >= –(PI_PROCESS–B), P gain = A/100, I gain = 1/(Bx Loop Time), If there is an error with PI settings, output –1.
26	PI_PROCESS	A is an input error, B is an output limit, C is the value of Const PI output. Range of C is 0–32, 767.

Number	Type	Description
27	UPCOUNT	Upcounts the pulses and then output the value– UPCOUNT(A, B, C). After receiving a trigger input (A), outputs are upcounted by C conditions. If the B inputs is 1, do not operate and display 0. If the B inputs is 0, operate. If the C parameter is 0, upcount when the input at A changes from 0 to 1. If the C parameter is 1, upcount when the input at A is changed from 1 to 0. If the C parameter is 2, upcount whenever the input at A changes. Output range is: 0–32767
28	DOWNCOUNT	Downcounts the pulses and then output the value– DOWNCOUNT(A, B, C). After receiving a trigger input (A), outputs are downcounted by C conditions. If the B input is 1, do not operate and display the initial value of C. If the B input is 0, operate. Downcounts when the A parameter changes from 0 to 1.

NOTE: The Pl process block (Pl_PROCESS Block) must be used after the PI control block (PI_CONTROL Block) for proper Pl control operation. Pl control operation cannot be performed if there is another block between the two blocks, or if the blocks are placed in an incorrect order.
For Programming Examples, see the support resources section on the drive item page on the webstore.

Fire Mode Operation

This function is used to allow the drive to ignore minor faults during emergency situations, such as fire, and provides continuous operation to fire pumps.

When turned on, Fire mode forces the drive to ignore all minor fault trips and repeat a Reset and Restart for major fault trips, regardless of the restart trial count limit. The retry delay time set at PR. 10 (Retry Delay) still applies while the drive performs a Reset and Restart.

Fire Mode Parameter Settings

Pr. Group	Pr. Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
Ad	80	Fire Mode selection	Fire Mode Sel	1	Fire Mode	0–2	–
	81	Fire Mode frequency	Fire Mode Freq	0–60		0–60	–
	82	Fire Mode run direction	Fire Mode Dir	0–1		0–1	–
	83	Fire Mode operation count	Fire Mode Cnt	Not configurable		–	–
In	65–69	Px terminal configuration	Px Define (Px: P1– P5)	51	Fire Mode	0–54	–

The drive runs in Fire mode when Ad. 80 (Fire Mode Sel) is set to '2 (Fire Mode)', and the multi–function terminal (In. 65–69) configured for Fire mode (51: Fire Mode) is turned on. The Fire mode count increases by 1 at Ad. 83 (Fire Mode Count) each time a Fire mode operation is run.

CAUTION: Fire mode operation may result in drive malfunction. Note that Fire mode operation voids the product warranty – the drive is covered by the product warranty only when the Fire mode count is '0.'

Fire Mode Function Setting Details

Pr. Code	Description	Details
Ad.81 Fire Mode frequency	Fire mode frequency reference	The frequency set at Ad. 81 (Fire mode frequency) is used for the drive operation in Fire mode. The Fire mode frequency takes priority over the Jog frequency, Multi–step frequencies, and the keypad input frequency.
dr.3 Acc Time / dr.4 Dec Time	Fire mode Acc/Dec times	When Fire mode operation is turned on, the drive accelerates for the time set at dr.3 (Acc Time), and then decelerates based on the deceleration time set at dr.4 (Dec Time). It stops when the Px terminal input is turned off (Fire mode operation is turned off).
Pr.10 Retry Delay	Fault trip process	Some fault trips are ignored during Fire mode operation. The fault trip history is saved, but trip outputs are disabled even when they are configured at the multi–function output terminals. • Fault trips that are ignored in Fire mode • BX, External Trip, Low Voltage Trip, Drive Overheat, Drive Overload, Overload, Electrical Thermal Trip, Input/Output Open Phase, Motor Overload, Fan Trip, No Motor Trips, and other minor fault trips. For the following fault trips, the drive performs a Reset and Restart until the trip conditions are released. The retry delay time set at PR. 10 (Retry Delay) applies while the drive performs a Reset and Restart. • Fault trips that force a Reset Restart in Fire mode • Over Voltage, Over Current1(OC1), Ground Fault Trip The drive stops operating when the following fault trips occur: • Fault trips that stop drive operation in Fire mode • H/W Diag, Over Current 2 (Arm–Short)

Improvement of output voltage drop

Improvement of the output voltage drop enables the output voltage operation command when the input voltage and overload settings are low to gain more output voltage and decrease the output current.

Parameter Setting for Improvement of Output Voltage Drop

Pr. Group	Pr. Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
Ad	87	Overmodulation mode selection	OVM Mod Sel	0	No	0–1	–

Pr. Code	Description	Details
Ad.87 OVM Mode Sel	Overmodulation mode selection	Setting Ad.87 (Overmodulation mode selection) as "No" limits command voltage to linear output range. Setting Ad.87 (Overmodulation mode selection) as "Yes" allows for the output of overmodulation area, which extends the range of the command voltage. The output voltage command area will be enlarged for more output voltage.

CAUTION:

- *Getting out of the linear range may cause waveform distortion.*
- *When the input voltage is higher than the motor-rated voltage, the motor output voltage may be higher than the rated voltage.*
- *The current value may vary quickly during a high-speed operation, but the current change amount will not increase by much.*
- *The compensation of the output voltage is less than the motor-rated voltage set in the parameter settings.*
- *Overmodulation mode does not operate when the input voltage is higher than the output voltage.*

Learning Advanced Features

This section describes the advanced features of the ACN drive. Check the reference page in the table to see the detailed description for each of the advanced features.

Advanced Tasks	Description	Ref.
Auxiliary frequency operation	Use the main and auxiliary frequencies in the predefined formulas to create various operating conditions. Auxiliary frequency operation is ideal for Draw Operation* as this feature enables fine–tuning of operation speeds.	4–126
Jog operation	Jog operation is a kind of a manual operation. The drive operates to a set of parameter settings predefined for Jog operation, while the Jog command button is pressed.	4–129
Up–down operation	Uses the upper and lower limit value switch output signals (i.e. signals from a flow meter) as Acc/Dec commands to motors.	4–132
3–wire operation	3–wire operation is used to latch an input signal. This configuration is used to operate the drive by a push button.	4–134
Safety operation mode	This safety feature allows the drive's operation only after a signal is input to the multi–function terminal designated for the safety operation mode. This feature is useful when extra care is needed in operating the drive using the multi–purpose terminals.	4–135
Dwell operation	Use this feature for the lift–type loads such as elevators, when the torque needs to be maintained while the brakes are applied or released.	4–136
Slip compensation	This feature ensures that the motor rotates at a constant speed, by compensating for the motor slip as a load increases.	4–138
PID control	PID control provides constant automated control of flow, pressure, and temperature by adjusting the output frequency of the drive.	4–139
Auto–tuning	Used to automatically measure the motor control parameters to optimize the drive's control mode performance.	4–146
Sensorless vector control	An efficient mode to control magnetic flux and torque without special sensors. Efficiency is achieved through the high torque characteristics at low current when compared with the V/F control mode.	4–148
Energy buffering operation	Used to maintain the DC link voltage for as long as possible by controlling the drive output frequency during power interruptions, thus to delay a low voltage fault trip.	4–162
Torque Control	Used to operate induction motors with a torque command.	4–164
Energy saving operation	Used to save energy by reducing the voltage supplied to motors during low–load and no–load conditions.	4–168
Speed search operation	Used to prevent fault trips when the drive voltage is output while the motor is idling or free–running.	4–169
Auto restart operation	Auto restart configuration is used to automatically restart the drive when a trip condition is released, after the drive stops operating due to activation of protective devices (fault trips).	4–172
Second motor operation	Used to switch equipment operation by connecting two motors to one drive. Configure and operate the second motor using the terminal input defined for the second motor operation.	4–174
Commercial power source switch operation	Used to switch the power source to the motor from the drive output to a commercial power source, or vice versa.	4–175
Cooling fan control	Used to control the cooling fan of the drive.	4–176
Multi-function IO Timer settings	Set the timer value and control the On/Off state of the multi–function output and relay.	4–183
Brake control	Used to control the On/Off operation of the load's electronic braking system.	4–184
Multi–function output On/Off control	Set standard values and turn On/Off the output relays or multi–function output terminals according to the analog input value.	4–185
Regeneration prevention for press operation.	Used during a press operation to avoid motor regeneration, by increasing the motor operation speed.	4–185

**Draw operation is an openloop tension control. This feature allows a constant tension to be applied to the material that is drawn by a motor–driven device, by fine–tuning the motor speed using operation frequencies that are proportional to a ratio of the main frequency reference.*

Operating with Auxiliary References

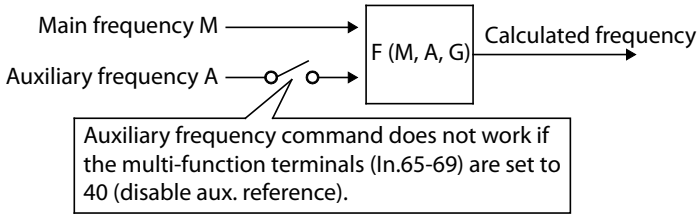
Frequency references can be configured with various calculated conditions that use the main and auxiliary frequency references simultaneously. The main frequency reference is used as the operating frequency, while auxiliary references are used to modify and fine–tune the main reference.

Pr. Group	Pr. Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
Operation	Frq	Frequency reference source	Freq Ref Src	0	Keypad–1	0–12	–
bA	01	Auxiliary frequency reference source	Aux Ref Src	1	V1	0–4	–
	02	Auxiliary frequency reference calculation type	Aux Calc Type	0	M+(G*A)	0–7	–
	03	Auxiliary frequency reference gain	Aux Ref Gain	0.0	–	–200.0–200.0	%
In	65– 69	Px terminal configuration	Px Define	40	dis Aux Ref	–	–

The table above lists the available calculated conditions for the main and auxiliary frequency references. Refer to the table to see how the calculations apply to an example where the Frq code has been set to 0(Keypad–1), and the drive is operating at a main reference frequency of 30.00 Hz. Signals at –10 – +10V are received at terminal V1, with the reference gain set at 5%. In this example, the resulting frequency reference is fine–tuned within the range of 27.00–33.00 Hz [Codes In.1–16 must be set to the default values, and In.6 (V1 Polarity), set to 1 (Bipolar)].

Auxiliary Reference Setting Details

<table>
<tr><th>Pr. Code</th><th colspan="3">Description</th></tr>
<tr><td rowspan="7">bA.1 Aux Ref Src</td><td colspan="3">Set the input type to be used for the auxiliary frequency reference</td></tr>
<tr><td>Configuration</td><td colspan="2">Description</td></tr>
<tr><td>0</td><td>None</td><td>Auxiliary frequency reference is disabled.</td></tr>
<tr><td>1</td><td>V1</td><td>Sets the V1 (voltage) terminal at the control terminal block as the source of auxiliary frequency reference.</td></tr>
<tr><td>3</td><td>V2</td><td>Sets the V2 (voltage) terminal at the control terminal block as the source of auxiliary frequency reference (SW2 must be set to “voltage”).</td></tr>
<tr><td>4</td><td>I2</td><td>Sets the I2 (current) terminal at the control terminal block as the source of auxiliary frequency reference (SW2 must be set to “current”).</td></tr>
<tr><td>5</td><td>Pulse</td><td>Sets the TI (pulse) terminal at the control terminal block as the source of auxiliary frequency reference.</td></tr>
<tr><td rowspan="11">bA.2 Aux Calc Type</td><td colspan="3">Set the auxiliary reference gain with bA.3 (Aux Ref Gain) to configure the auxiliary reference and set the percentage to be reflected when calculating the main reference. Note that items 4–7 below may result in either plus (+) or minus (–) references (forward or reverse operation) even when unipolar analog inputs are used.</td></tr>
<tr><td colspan="2">Configuration</td><td>Formula for frequency reference</td></tr>
<tr><td>0</td><td>M+(G*A)</td><td>Main reference+(bA.3xbA.1xIn.1)</td></tr>
<tr><td>1</td><td>M*(G*A)</td><td>x(bA.3xbA.1)</td></tr>
<tr><td>2</td><td>M/(G*A)</td><td>Main reference/(bA.3xbA.1)</td></tr>
<tr><td>3</td><td>M+{M*(G*A)}</td><td>Main reference+{Main reference x(bA.3xbA.1)}</td></tr>
<tr><td>4</td><td>M+G*2*(A–50)</td><td>Main reference+bA.3x2x(bA.1–50)x In.1</td></tr>
<tr><td>5</td><td>M*{G*2*(A–50)}</td><td>Main reference x{bA.3x2x(bA.1–50)}</td></tr>
<tr><td>6</td><td>M/{G*2*(A–50)}</td><td>Main reference/{bA.3x2x(bA.1–50)}</td></tr>
<tr><td>7</td><td>M+M*G*2*(A–50)</td><td>Main reference+Main reference x bA.3x2x(bA.1–50)</td></tr>
<tr><td colspan="3">M: Main frequency reference (Hz or rpm)
G: Auxiliary reference gain (%)
A: Auxiliary frequency reference (Hz or rpm) or gain (%)</td></tr>
<tr><td>bA.3 Aux Ref Gain</td><td colspan="3">Adjust the size of the input (bA.1 Aux Ref Src) configured for auxiliary frequency.</td></tr>
<tr><td>In.65–69 Px Define</td><td colspan="3">Set one of the multi–function input terminals to 40(dis Aux Ref) and turn it on to disable the auxiliary frequency reference. The drive will operate using the main frequency reference only.</td></tr>
</table>



Auxiliary Reference Operation Ex #1

Keypad Frequency Setting is Main Frequency and V1 Analog Voltage is Auxiliary Frequency

- *Main frequency: Keypad (operation frequency 30Hz)*
- *Maximum frequency setting (dr.20): 400Hz*
- *Auxiliary frequency setting (bA.1): V1[Display by percentage(%) or auxiliary frequency (Hz) depending on the operation setting condition]*
- *Auxiliary reference gain setting (bA.3): 50%*
- *In.1–32: Factory default*

Example: an input voltage of 6V is supplied to V1, and the frequency corresponding to 10V is 60Hz. The table below shows the auxiliary frequency A as 36Hz[=60Hz X (6V/10V)] or 60%[= 100% X (6V/10V)].

Setting*		Calculating final command frequency**
0	M[Hz]+(G%*A[Hz])	30Hz(M)+(50%(G)x36Hz(A))=48Hz
1	M[Hz]*(G%*A%)	30Hz(M)x(50%(G)x60%(A))=9Hz
2	M[Hz]/(G%*A%)	30Hz(M)/(50%(G)x60%(A))=100Hz
3	M[Hz]+{M[Hz]*(G%*A%)}	30Hz(M)+{30[Hz]x(50%(G)x60%(A))}=39Hz
4	M[Hz]+G%*2*(A%–50%)[Hz]	30Hz(M)+50%(G)x2x(60%(A)–50%)x60Hz=36Hz
5	M[HZ]*{G%*2*(A%–50%)}	30Hz(M)x{50%(G)x2x(60%(A)–50%)}=3Hz
6	M[HZ]/{G%*2*(A%–50%)}	30Hz(M)/{50%(G)x2x(60%–50%)}=300Hz
7	M[HZ]+M[HZ]*G%*2*(A%–50%)	30Hz(M)+30Hz(M)x50%(G)x2x(60%(A)–50%)=33Hz
**M: main frequency reference (Hz or rpm)/G: auxiliary reference gain (%)/A: auxiliary frequency reference (Hz or rpm) or gain (%).* ***If the frequency setting is changed to rpm, it is converted to rpm instead of Hz.*		

Auxiliary Reference Operation Ex #2

Keypad Frequency Setting is Main Frequency and I2 Analog Voltage is Auxiliary Frequency

- *Main frequency: Keypad (Operation frequency 30Hz)*
- *Maximum frequency setting (dr.20): 400Hz*
- *Auxiliary frequency setting (bA.1): I2 [Display by percentage(%) or auxiliary frequency(Hz) depending on the operation setting condition]*
- *Auxiliary reference gain setting (bA.3): 50%*
- *In.1–32: Factory default*

Example: an input current of 10.4 mA is applied to I2, with the frequency corresponding to 20mA of 60Hz. The table below shows auxiliary frequency A as 24Hz(=60[Hz] X {(10.4[mA]–4[mA])/(20[mA] – 4[mA])} or 40%(=100% X {(10.4[mA] – 4[mA])/(20[mA] – 4[mA])}.

Setting*		Calculating final command frequency**
0	M[Hz]+(G%*A[Hz])	30Hz(M)+(50%(G)x24Hz(A))=42Hz
1	M[Hz]*(G%*A%)	30Hz(M)x(50%(G)x40%(A))=6Hz
2	M[Hz]/(G%*A%)	30Hz(M)/(50%(G)x40%(A))=150Hz
3	M[Hz]+{M[Hz]*(G%*A%)}	30Hz(M)+{30[Hz]x(50%(G)x40%(A))}=36Hz
4	M[Hz]+G%*2*(A%–50%)[Hz]	30Hz(M)+50%(G)x2x(40%(A)–50%)x60Hz=24Hz
5	M[HZ]*{G%*2*(A%–50%)	30Hz(M)x{50%(G)x2x(40%(A)–50%)} = –3Hz(Reverse)
6	M[HZ]/{G%*2*(A%–50%)}	30Hz(M)/{50%(G)x2x(60%–40%)} = –300Hz(Reverse)
7	M[HZ]+M[HZ]*G%*2*(A%–50%)	30Hz(M)+30Hz(M)x50%(G)x2x (40%(A)–50%)=27Hz
**M: main frequency reference (Hz or rpm)/G: auxiliary reference gain (%)/A: auxiliary frequency reference Hz or rpm) or gain (%).* ***If the frequency setting is changed to rpm, it is converted to rpm instead of Hz.*		

Auxiliary Reference Operation Ex #3

V1 is Main Frequency and I2 is Auxiliary Frequency

- *Main frequency: V1 (frequency command setting to 5V and is set to 30Hz)*
- *Maximum frequency setting (dr.20): 400Hz*
- *Auxiliary frequency (bA.1): I2[Display by percentage (%) or auxiliary frequency (Hz) depending on the operation setting condition]*
- *Auxiliary reference gain (bA.3): 50%*
- *In.1–32: Factory default*

Example: an input current of 10.4 mA is applied to I2, with the frequency corresponding to 20mA of 60Hz. The table below shows auxiliary frequency Aas 24Hz(=60[Hz]x{(10.4[mA]–4[mA])/(20[mA]–4[mA])} or 40%(=100% x {(10.4[mA] – 4[mA]) /(20 [mA] – 4[mA])}.

Setting*		Calculating final command frequency**
0	M[Hz]+(G%*A[Hz])	30Hz(M)+(50%(G)x24Hz(A))=42Hz
1	M[Hz]*(G%*A%)	30Hz(M)x(50%(G)x40%(A))=6Hz
2	M[Hz]/(G%*A%)	30Hz(M)/(50%(G)x40%(A))=150Hz
3	M[Hz]+{M[Hz]*(G%*A%)}	30Hz(M)+{30[Hz]x(50%(G)x40%(A))}=36Hz
4	M[Hz]+G%*2*(A%–50%)[Hz]	30Hz(M)+50%(G)x2x(40%(A)–50%)x60Hz=24Hz
5	M[HZ]*{G%*2*(A%–50%)}	30Hz(M)x{50%(G)x2x(40%(A)–50%)}=–3Hz(Reverse)
6	M[HZ]/{G%*2*(A%–50%)}	30Hz(M)/{50%(G)x2x(60%–40%)}=–300Hz(Reverse)
7	M[HZ]+M[HZ]*G%*2*(A%–50%)	30Hz(M)+30Hz(M)x50%(G)x2x(40%(A)–50%)=27Hz

**M: main frequency reference (Hz or rpm)/G: auxiliary reference gain (%)/A: auxiliary frequency reference (Hz or rpm) or gain (%).*
***If the frequency setting is changed to rpm, it is converted to rpm instead of Hz.,*

NOTE: When the maximum frequency value is high, output frequency deviation may result due to analog input variation and deviations in the calculations.

Jog operation

The jog operation allows for a temporary control of the drive. You can enter a jog operation command using the multi–function terminals or by using the [ESC] key on the keypad.

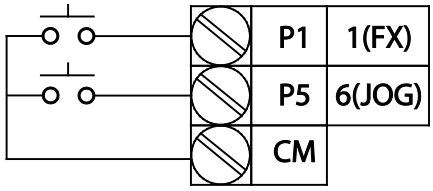
The jog operation is the second highest priority operation, after the dwell operation. If a jog operation is requested while operating the multi–step, up–down, or 3–wire operation modes, the jog operation overrides all other operation modes.

Jog Operation 1–Forward Jog by Multi–function Terminal

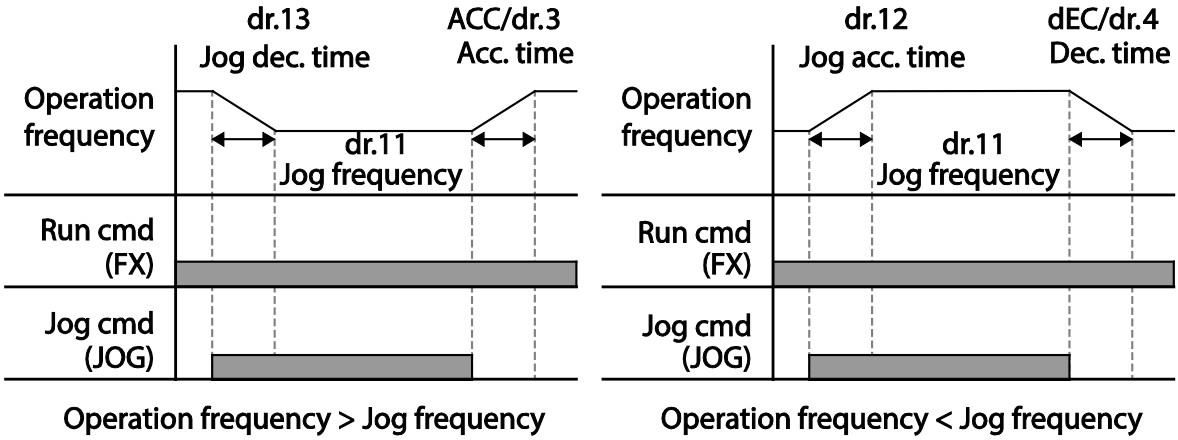
The jog operation is available in either forward or reverse direction, using the keypad or multi–function terminal inputs. The table below lists parameter setting for a forward jog operation using the multi–function terminal inputs.

Pr. Group	Pr. Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
dr	11	Jog frequency	JOG Frequency	10.00		0.50–Maximum frequency	Hz
	12	Jog operation acceleration time	JOG Acc Time	20.00		0.00–600.00	sec
	13	Jog operation deceleration time	JOG Dec Time	30.00		0.00–600.00	sec
In	65–69	Px terminal configuration	Px Define(Px: P1–P5)	6	JOG	0–54	–

Forward Jog Description Details

Pr. Code	Description
In.65–69 Px Define	Select the jog frequency from P1– P5 and then select 6. Jog from In.65–69.  Terminal settings for jog operation
dr.11 JOG Frequency	Set the operation frequency.
dr.12 JOG Acc Time	Set the acceleration speed.
dr.13 JOG Dec Time	Set the deceleration speed.

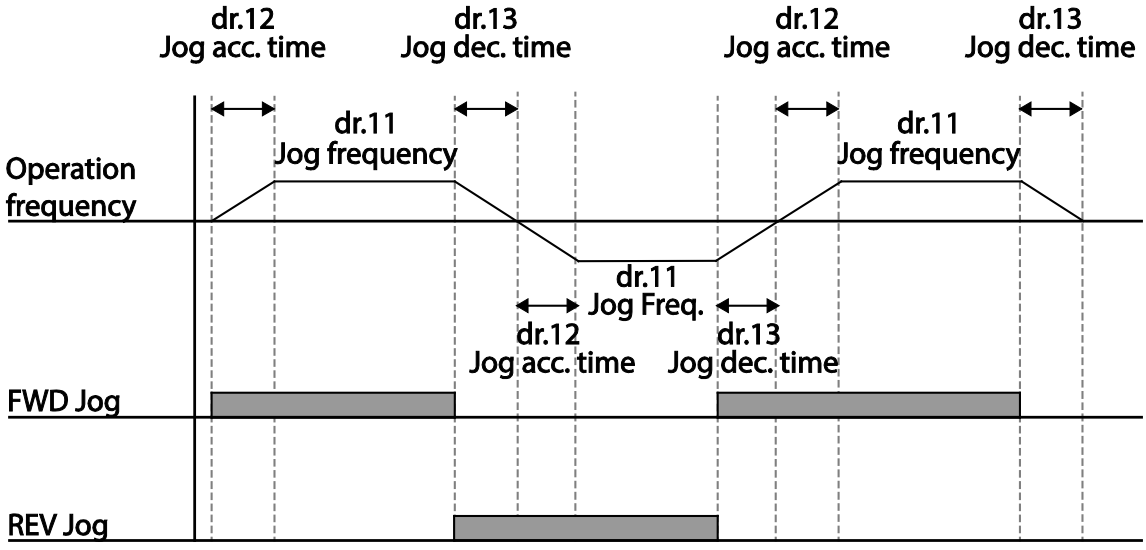
If a signal is entered at the jog terminal while an FX operation command is on, the operation frequency changes to the jog frequency and the jog operation begins.



Jog Operation 2–Fwd/Rev Jog by Multi–function Terminal

For jog operation 1, an operation command must be entered to start operation, but while using jog operation 2, a terminal that is set for a forward or reverse jog also starts an operation. The priorities for frequency, Acc/Dec time and terminal block input during operation in relation to other operating modes (Dwell, 3–wire, up/down, etc.) are identical to jog operation 1. If a different operation command is entered during a jog operation, it is ignored and the operation maintains the jog frequency.

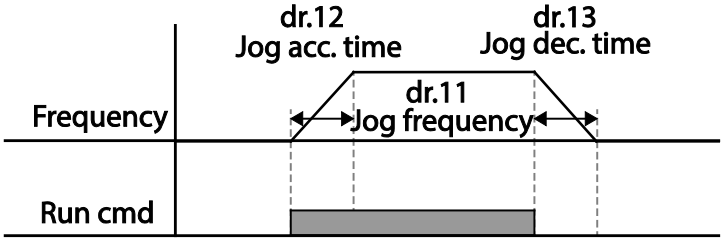
Pr. Group	Pr. Code	Name	LCD Display	Parameter setting		Setting Range	Unit
dr	11	Jog frequency	JOG Frequency	10.00		0.50–Maximum frequency	Hz
	12	Jog operation acceleration time	JOG Acc Time	20.00		0.00–600.00	sec
	13	Operation deceleration time	JOG Dec Time	30.00		0.00–600.00	sec
In	65–69	Px terminal configuration	Px Define(Px: P1–P5)	46	FWD JOG	0–54	–
				47	REV JOG		



Jog Operation by Keypad

Pr. Group	Pr. Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
Dr	90	[ESC] key functions	–	1	JOG Key	–	–
	06	Command source	Cmd Source*	0	Keypad	–	–
**Displayed under DRV–06 on the LCD keypad.*							

Set dr.90 to 1(JOG Key) and set the drv code in the Operation group to 0(Keypad). When the [ESC] key is pressed, the SET display light flashes and the jog operation is ready to start. Pressing the [RUN] key starts the operation and the drive accelerates or decelerates to the designated jog frequency. Releasing the [RUN] key stops the jog operation. Set the Acc/Dec time for the jog operation frequency at dr.12 and dr.13.

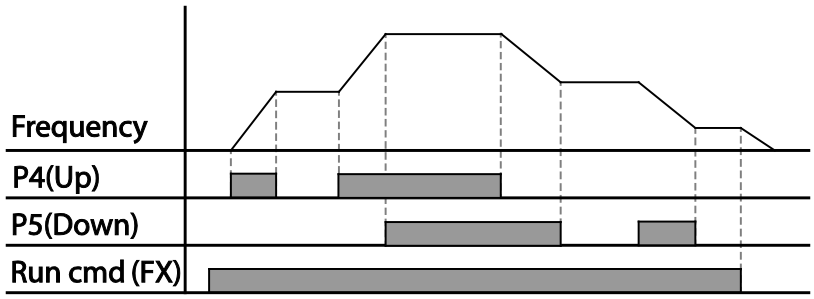
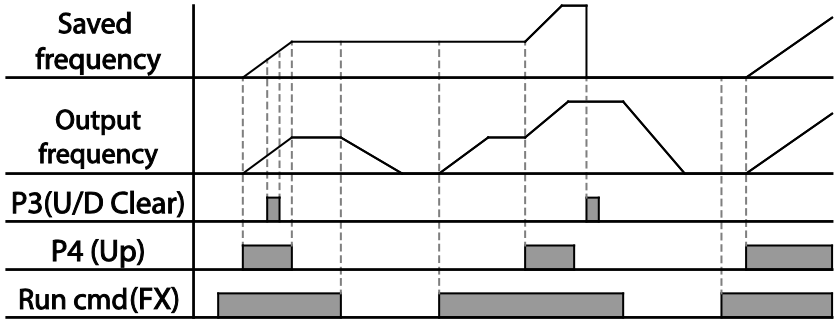


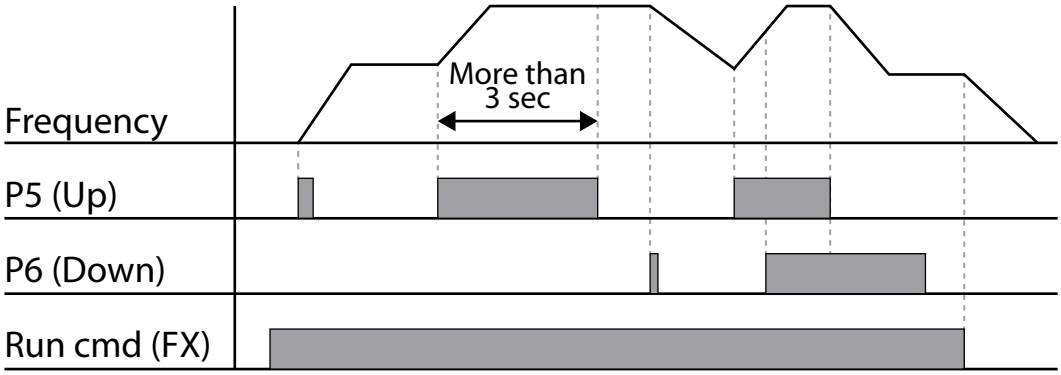
Up–down Operation

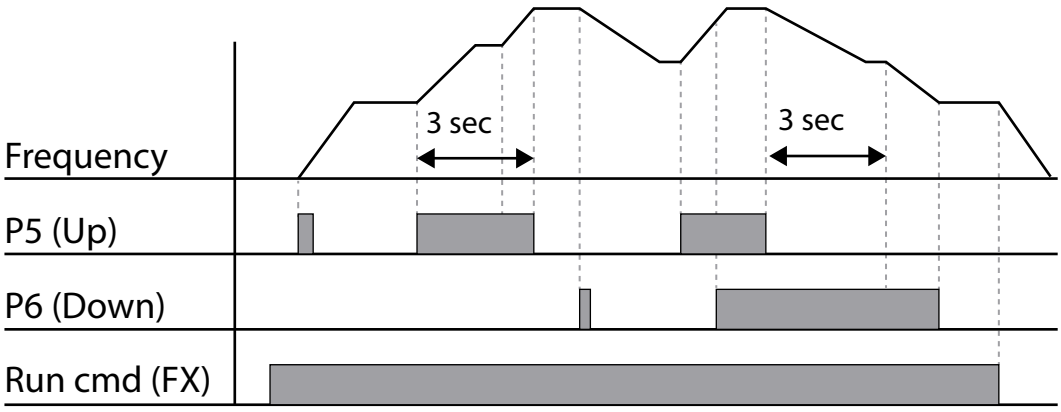
The Acc/Dec time can be controlled through input at the multi–function terminal block. Similar to a flowmeter, the up–down operation can be applied easily to a system that uses the upper–lower limit switch signals for Acc/Dec commands.

Pr. Group	Pr. Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
Ad	65	Up–down operation frequency save	U/D Save Mode	1	Yes	0–1	–
	85	Up–down mode selection	U/D Mode Sel	0	U/D Normal	0–2	–
				1	U/D Step		
				2	U/D Step+ Norm		
	86	Up–down step frequency	U/D Step Freq	0–maxFreq		0–Maximum Frequency	Hz
In	65–69	Px terminal configuration	Px Define(Px: P1–P5)	17	Up	0–54	–
				18	Down		
				20	U/D Clear		

Up–down Operation Setting Details

Pr. Code	Description
In.65–69 Px Define	Select two terminals for up–down operation and set them to 17 (Up) and 18 (Down), respectively. With the operation command input, acceleration begins when the Up terminal signal is on. Acceleration stops and constant speed operation begins when the signal is off. During operation, deceleration begins when the Down signal is on. Deceleration stops and constant speed operation begins when both Up and Down signals are entered at the same time. 
Ad.65 U/D Save Mode	During a constant speed operation, the operating frequency is saved automatically in the following conditions: the operation command (Fx or Rx) is off, a fault trip occurs, or the power is off. When the operation command is turned on again, or when the drive regains the power source or resumes to a normal operation from a fault trip, it resumes operation at the saved frequency. To delete the saved frequency, use the multi–function terminal block. Set one of the multi–function terminals to 20 (U/D Clear) and apply signals to it during constant speed operation. The saved frequency and the up–down operation configuration will be deleted. 

<table>
<tr><th>Pr. Code</th><th colspan="3">Description</th></tr>
<tr><td rowspan="6">Ad.85 U/D Mode Sel</td><td colspan="3">Select up-down operation mode.</td></tr>
<tr><td colspan="2">Setting</td><td>Function</td></tr>
<tr><td>0</td><td>U/D Normal</td><td>Pressing the Up button increases the frequency to the maximum setting at a preset acceleration time. Pressing the Down button decreases the frequency to a preset deceleration speed, regardless of stop mode.</td></tr>
<tr><td>1</td><td>U/D Step</td><td>Accelerate or decelerate according to the step frequency set in Ad.86 on the ascending edge of the multi-function input set for up-down operation mode.</td></tr>
<tr><td>2</td><td>U/D Step+Norm</td><td>Accelerate or decelerate according to the step frequency set in Ad.86 on the ascending edge of the multi-function input set for up-down operation mode. If acceleration or deceleration is activated more than 3 seconds, the operation settings will change to up-down normal mode.</td></tr>
<tr><td colspan="3"> 

U/D Step
 

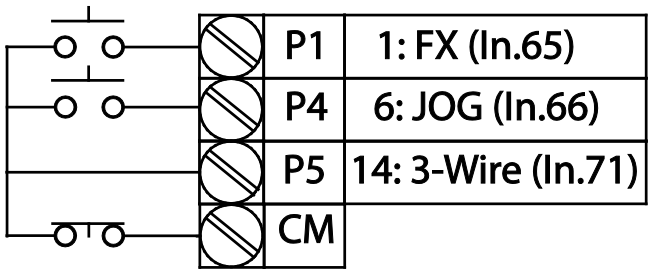
U/D Step+Norm</td></tr>
<tr><td>Ad.86 U/D Step Freq</td><td colspan="3">Set the frequency value to increase or decrease based on the up or down input.</td></tr>
</table>

3–Wire Operation

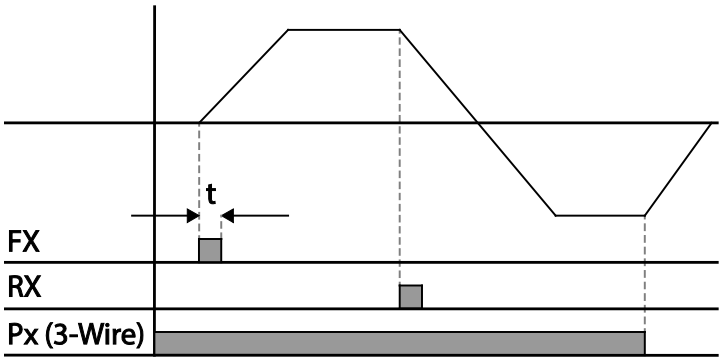
The 3–wire operation latches the signal input (the signal stays on after the button is released), and is used when operating the drive with a push button.

Pr. Group	Pr. Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
Operation	drv	Command source	Cmd Source*	1	Fx/Rx – 1	–	–
In	65–69	Px terminal configuration	Px Define(Px: P1–P5)	14	3–Wire	0–54	–
**Displayed under DRV–06 on an LCD keypad.*							

To enable the 3–wire operation, the following circuit sequence is necessary. The minimum input time (t) for 3–wire operation is 1ms, and the operation stops when both forward and reverse operation commands are entered at the same time.



Terminal connections for 3–wire operation



3–wire operation

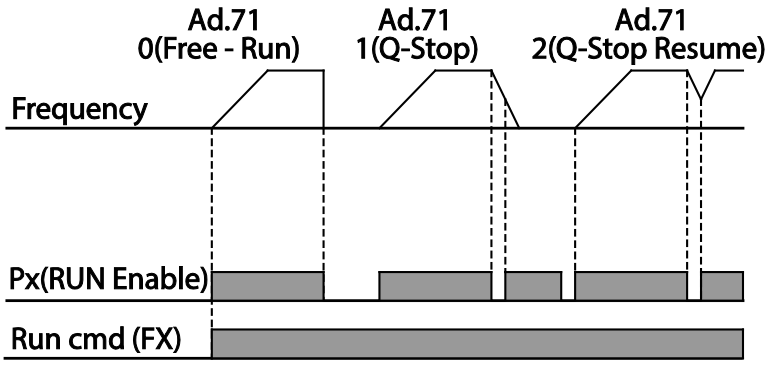
Safe Operation Mode

When the multi–function terminals are configured to operate in safe mode, operation commands can be entered in the Safe operation mode only. Safe operation mode is used to safely and carefully control the drive through the multi–function terminals.

Pr. Group	Pr. Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
Ad	70	Safe operation selection	Run En Mode	1	DI Dependent	–	–
	71	Safe operation stop mode	Run Dis Stop	0	Free–Run	0–2	–
	72	Safe operation deceleration time	Q–Stop Time	5.0		0.0–600.0	sec
In	65–69	Px terminal configuration	Px Define(Px: P1–P5)	13	RUN Enable	0–54	–

Safe Operation Mode Setting Details

Pr. Code	Description		
In.65–69 Px Define	From the multi–function terminals, select a terminal to operate in safe operation mode and set it to 13 (RUN Enable).		
Ad.70 Run En Mode	Setting		Function
	0	Always Enable	Enables safe operation mode.
	1	DI Dependent	Recognizes the operation command from a multi–function input terminal.
Ad.71 Run Dis Stop	Set the operation of the drive when the multi–function input terminal in safe operation mode is off.		
	Setting		Function
	0	Free–Run	Blocks the drive output when the multi–function terminal is off.
	1	Q–Stop	The deceleration time (Q–Stop Time) used in safe operation mode. It stops after deceleration and then the operation can resume only when the operation command is entered again. The operation will not begin if only the multi–function terminal is on.
	2	Q–Stop Resume	The drive decelerates to the deceleration time (Q–Stop Time) in safe operation mode. It stops after deceleration. Then if the multi–function terminal is on, the operation resumes as soon as the operation command is entered again.
Ad.72 Q–Stop Time	Sets the deceleration time when Ad.71 (Run Dis Stop) is set to 1 (Q–Stop) or 2 (Q–Stop Resume).		



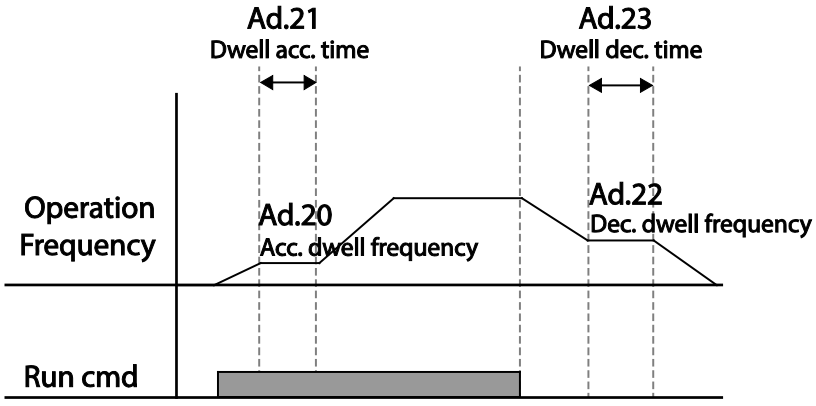
Dwell Operation

The dwell operation is used to maintain torque during the application and release of the brakes on lift–type loads. Drive dwell operation is based on the Acc/Dec dwell frequency and the dwell time set by the user. The following points also affect dwell operation:

- *Acceleration Dwell Operation: When an operation command runs, acceleration continues until the acceleration dwell frequency and constant speed is reached within the acceleration dwell operation time (Acc Dwell Time). After the Acc Dwell Time has passed, acceleration is carried out based on the acceleration time and the operation speed that was originally set.*
- *Deceleration Dwell Operation: When a stop command is run, deceleration continues until the deceleration dwell frequency and constant speed is reached within the deceleration dwell operation time (Dec Dwell Freq). After the set time has passed, deceleration is carried out based on the deceleration time that was originally set, then the operation stops.*

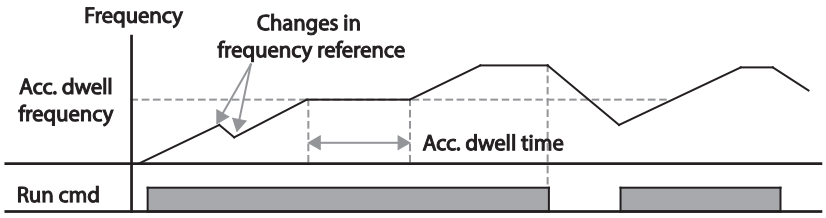
When dr.9 (Control Mode) is set to 0 (V/F), the drive can be used for operations with dwell frequency before opening the mechanical brake of lift–type loads, such as an elevator.

Pr. Group	Pr. Code	Name	LCD Display	Parameter Setting	Setting Range	Unit
Ad	20	Dwell frequency during acceleration	Acc Dwell Freq	5.00	Start frequency – Maximum frequency	Hz
	21	Operation time during acceleration	Acc Dwell Time	0.0	0.0–10.0	s
	22	Dwell frequency during deceleration	Dec Dwell Freq	5.00	Start frequency – Maximum frequency	Hz
	23	Operation time during deceleration	Dec Dwell Time	0.0	0 .0–60.0	s



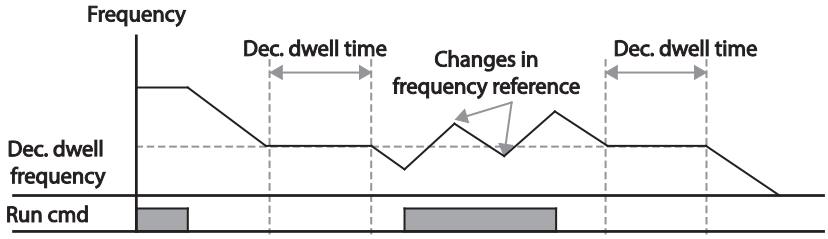
NOTE: Dwell operation does not work when:

- *Dwell operation time is set to 0 sec or dwell frequency is set to 0 Hz.*
- *Re-acceleration is attempted from stop or during deceleration, as only the first acceleration dwell operation command is valid.*



Acceleration dwell operation

Although deceleration dwell operation is carried out whenever stop commands are entered and the deceleration dwell frequency is passed through, it does not work during a deceleration by simple frequency change (which is not a deceleration due to a stop operation), or during external brake control applications.



Deceleration dwell operation

CAUTION: WHEN A DWELL OPERATION IS CARRIED OUT FOR A LIFT – TYPE LOAD BEFORE ITS MECHANICAL BRAKE IS RELEASED, MOTORS CAN BE DAMAGED OR THEIR LIFECYLE REDUCED DUE TO OVERFLOW CURRENT IN THE MOTOR.

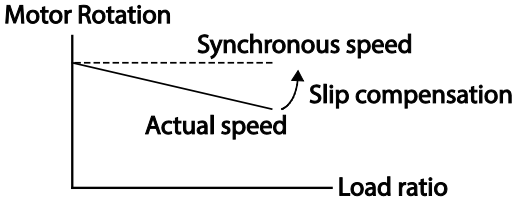
Slip Compensation Operation

Slip refers to the variation between the setting frequency (synchronous speed) and motor rotation speed. As the load increases there can be variations between the setting frequency and motor rotation speed. Slip compensation is used for loads that require compensation of these speed variations.

Pr. Group	Pr. Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
dr	09	Control mode	Control Mode	2	Slip Compen	–	–
	14	Motor capacity	Motor Capacity	2	0.75 kW (0.75 kW based)	0–15	–
bA	11	Number of motor poles	Pole Number	4		2–48	–
	12	Rated slip speed	Rated Slip	90 (0.75 kW based)		0–3000	rpm
	13	Rated motor current	Rated Curr	3.6 (0.75 kW based)		1.0–1000.0	A
	14	Motor no–load current	Noload Curr	1.6 (0.75 kW based)		0.5–1000.0	A
	16	Motor efficiency	Efficiency	72 (0.75 kW based)		64–100	%
	17	Load inertia rate	Inertia Rate	0 (0.75 kW based)		0–8	–

Slip Compensation Operation Setting Details

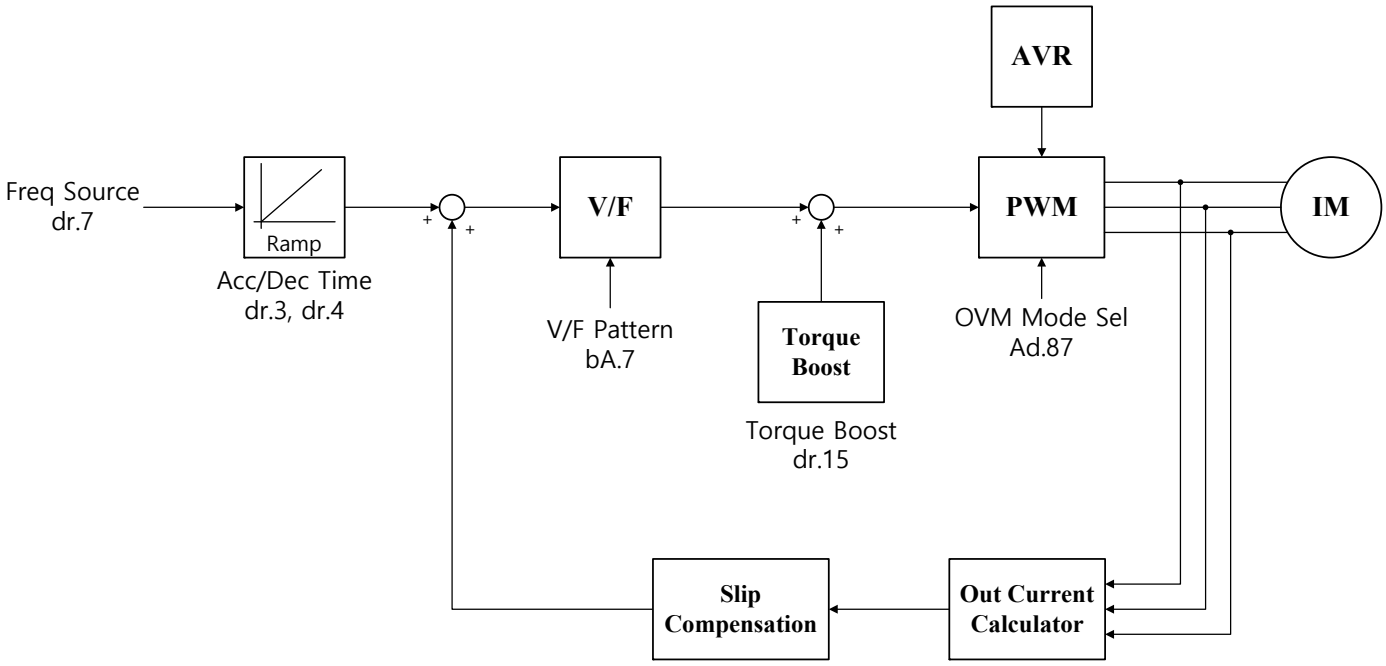
Pr. Code	Description	
dr.9 Control Mode	Set dr.9 to 2 (Slip Compen) to carry out the slip compensation operation.	
dr.14 Motor Capacity	Set the capacity of the motor connected to the drive.	
bA.11 Pole Number	Enter the number of poles from the motor rating plate.	
bA.12 Rated Slip	Enter the rated slip in rpm. (Slip rpm = Synchronous RPM - Nameplate RPM) For example, a 4 pole motor with nameplate of 1725 RPM. Slip RPM = 1800 - 1725 = 75 RPM ba.12 = 75	
bA.13 Rated Curr	Enter the rated current from the motor rating plate.	
bA.14 Noload Curr	Enter the measured current when the load on the motor axis is removed and when the motor is operated at the rated frequency. If no–load current is difficult to measure, enter a current equivalent to 30–50% of the rated motor current.	
bA.16 Efficiency	Enter the efficiency from the motor rating place.	
bA.17 Inertia Rate	Select load inertia based on motor inertia.	
	Setting	Function
	0	Less than 10 times motor inertia
	1	10 times motor inertia
	2–8	More than 10 times motor inertia
	$f_s = f_r - \frac{Rpm \times P}{120}$ f(s)=Rated slip frequency f(r)=Rated frequency rpm=Number of the rated motor rotations P=Number of motor poles	



Slip Compensation Control Block Diagram

IM V/F Control (IMVF+with Slip compensation)

When dr.9 is set to 2: Slip Compen, the V/F control with Slip comp. diagram is as shown here:



PID Control

PiD control is one of the most common auto–control methods. It uses a combination of proportional, integral, and differential (PID) control that provides more effective control for automated systems. The functions of PID control that can be applied to the drive operation are as follows:

Purpose	Function
Speed control	Controls speed by using feedback about the existing speed level of the equipment or machinery to be controlled. Control maintains consistent speed or operates at the target speed.
Pressure control	Controls pressure by using feedback about the existing pressure level of the equipment or machinery to be controlled. Control maintains consistent pressure or operates at the target pressure.
Flow control	Controls flow by using feedback about the amount of existing flow in the equipment or machinery to be controlled. Control maintains consistent flow or operates at a target flow.
Temperature control	Controls temperature by using feedback about the existing temperature level of the equipment or machinery to be controlled. Control maintains a consistent temperature or operates at a target temperature.

PID Basic Operation

PID operates by controlling the output frequency of the drive, through automated system process control to maintain speed, pressure, flow, temperature and tension.

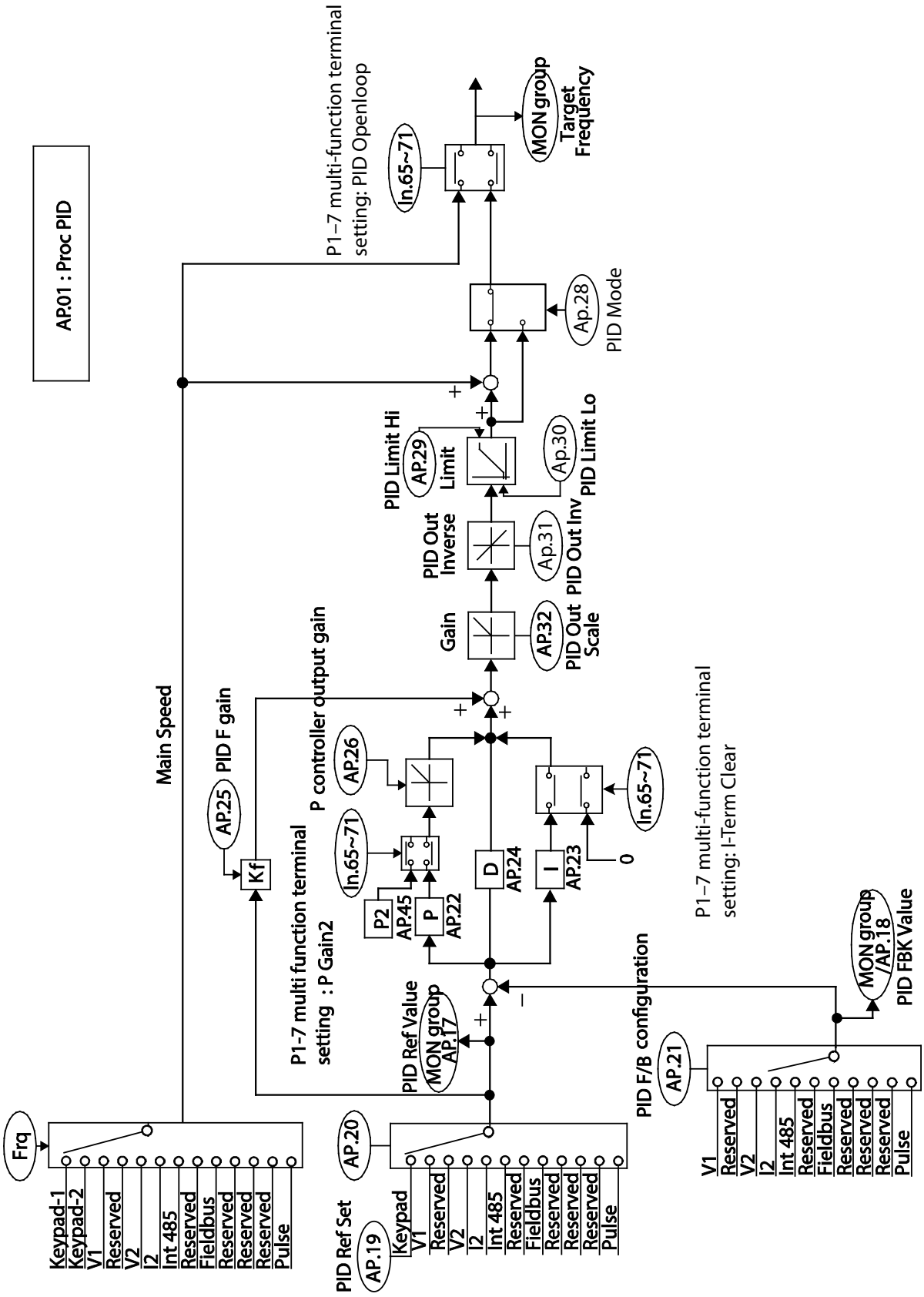
Pr. Group	Pr. Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
AP	01	Application function selection	App Mode	2	Proc PID	0–2	–
	16	PID output monitor	PID Output	–		–	–
	17	PID reference monitor	PID Ref Value	–		–	–
	18	PID feedback monitor	PID Fdb Value	–		–	–
	19	PID reference setting	PID Ref Set	50.00		–100.00–100.00	%
	20	PID reference source	PID Ref Source	0	Keypad	0–11	–
	21	PID feedback source	PID F/B Source	0	V1	0–10	–
	22	PID controller proportional gain	PID P–Gain	50.0		0.0–1000.0	%
	23	PID controller integral time	PID I–Time	10.0		0.0–200.0	sec
	24	PID controller differential time	PID D–Time	0		0–1000	msec
	25	PID controller feed–forward compensation gain	PID F–Gain	0.0		0–1000	%
	26	Proportional gain scale	P Gain Scale	100.0		0.0–100.0	%
	27	PID output filter	PID Out LPF	0		0–10000	ms
	28	PID mode	PID mode	0	Process PID	0–1	
	29	PID maximum frequency	PID Limit Hi	60.00		–300.00–300.00	Hz
	30	PID minimum frequency	PID Limit Lo	0.5		–300.00–300.00	Hz
	31	PID output reverse	PID Out Inv	0	No	0–1	–
	32	PID output scale	PID Out Scale	100.0		0.1–1000.0	%
	34	PID controller motion frequency	Pre–PID Freq	0.00		0–Maximum frequency	Hz
	35	PID controller motion level	Pre–PID Exit	0.0		0.0–100.0	%
	36	PID controller motion delay time	Pre–PID Delay	600		0–9999	sec
	37	PID sleep mode delay time	PID Sleep DT	60.0		0–999.9	sec
	38	PID sleep mode frequency	PID Sleep Freq	0.00		0–Maximum frequency	Hz
	39	PID wake–up level	PID WakeUp Lev	35		0–100	%
AP	40	PID wake–up mode selection	PID WakeUp Mod	0	Below Level	0–2	–
	42	PID controller unit selection	PID Unit Sel	0	%	0–12	–
	43	PID unit gain	PID Unit Gain	100.0		0–300	%
	44	PID unit scale	PID Unit Scale	2	x 1	0–4	–
	45	PID 2nd proportional gain	PID P2–Gain	100.00		0–1000	%
In	65–69	Px terminal configuration	Px Define (Px: P1–P5)	22	I–Term Clear	0–54	–
				23	PID Openloop		
				24	P Gain2		

PID Basic Operation Setting Details

Pr. Code	Description		
AP.1 App Mode	Set the code to 2 (Proc PID) to select functions for the process PID.		
AP.16 PID Output	Displays the existing output value of the PID controller. The unit, gain, and scale that were set at AP. 42–44 are applied on the display.		
AP.17 PID Ref Value	Displays the existing reference value set for the PID controller. The unit, gain, and scale that were set at AP. 42–44 are applied on the display.		
AP.18 PID Fdb Value	Displays the input value of the PID controller that is included in the latest feedback. The unit, gain, and scale that were set at AP. 42–44 are applied on the display.		
AP.19 PID Ref Set	When AP.20 (PID control reference source) is set to 0 (Keypad), the reference value can be entered. If the reference source is set to any other value, the setting values for AP.19 are void.		
AP.20 PID Ref Source	Selects the reference input for the PID control. If the V1 terminal is set to PID feedback source (PID F/B Source), the V1 terminal cannot be set to the PID reference source (PID Ref Source). To set V1 as a reference source, change the feedback source.		
	Setting		Function
	0	Keypad	Keypad
	1	V1	–10–10V input voltage terminal
	3	V2	I2 analog input terminal [When analog voltage/current input terminal selection switch (SW2) at the terminal block is set to I (current), input 4–20 mA current. If it is set to V (voltage), input 0–10V voltage]
	4	I2	
	5	Int. 485	RS–485 input terminal
	7	FieldBus (Ethernet)	Communication command via a communication option card
	9	UserSeqLink	Link the common area with the user sequence output.
	11	Pulse	TI Pulse input terminal (0–32 kHz Pulse input)
	When using the keypad, the PID reference setting can be displayed at AP.17. When using the LDC keypad, the PID reference setting can be monitored from the config mode (CNF) –06–08, set to 17 (PID Ref Value).		
AP.21 PID F/B Source	Selects feedback input for PID control. Items can be selected as reference input, except the keypad input (Keypad–1 and Keypad–2). Feedback cannot be set to an input item that is identical to the item selected as the reference. For example, when Ap.20 (Ref Source) is set to 1 (V1), for AP. 21 (PID F/B Source), an input other than the V1 terminal must be selected. When using the LCD keypad, the volume of feedback can be monitored using a code from the config mode (CNF) –06–08, by setting it to 18 (PID Fbk Value).		
AP.22 PID P–Gain, AP.26 P Gain Scale	Sets the output ratio for differences (errors) between reference and feedback. If the Pgain is set to 50%, then 50% of the error is output. The setting range for Pgain is 0.0–1, 000%. For ratios below 0.1%, use AP.26 (P Gain Scale).		
AP.23 PID I– Time	Sets the time to output accumulated errors. When the error is 100%, the time taken for 100% output is set. When the integral time (PID I–Time) is set to 1 second, 100% output occurs after 1 second of the error remaining at 100%. Differences in a normal state can be reduced by PID I Time. When the multi–function terminal block is set to 21(I–Term Clear) and is turned on, all of the accumulated errors are deleted.		
AP.24 PID D–Time	Sets the output volume for the rate of change in errors. If the differential time (PID D–Time) is set to 1ms and the rate of change in errors per sec is 100%, output occurs at 1% per 10ms.		
AP.25 PID F–Gain	Sets the ratio that adds the target to the PID output. Adjusting this value leads to a faster response.		
AP.27 PID Out LPF	Used when the output of the PID controller changes too fast or the entire system is unstable, due to severe oscillation. In general, a lower value (default value=0) is used to speed up response time, but in some cases a higher value increases stability. The higher the value, the more stable the PID controller output is, but the slower the response time.		
AP.28 PID Mode	By default, parameter AP.28 is set to "Proc PID". This adds the main frequency reference based on the setting in frq/DRV07. This is more commonly suited for industrial applications that may be running a PID loop with a trim input. If you are running a fan or pump application with a PID loop it is recommended to set this to "Normal PID". Reference the function block diagram for more info.		
AP.29 PID Limit Hi, AP.30 PID Limit Lo	Limits the output of the controller.		
AP.32 PID Out Scale	Adjusts the volume of the controller output.		

Pr. Code	Description		
AP.42 PID Unit Sel	Sets the unit of the control variable (available only on the LCD keypad).		
	Setting		Function
	0	%	Displays a percentage without a physical quantity given.
	1	Bar	Various units of pressure can be selected.
	2	mBar	
	3	Pa	
	4	kPa	
	5	Hz	Displays the drive output frequency or the motor rotation speed.
	6	rpm	
	7	V	Displays in voltage/current/power/horsepower.
	8	I	
	9	kW	
	10	HP	
	11	°C	Displays in Celsius or Fahrenheit.
	12	°F	
AP.43 PID Unit Gain, AP.44 PID Unit Scale	Adjusts the size to fit the unit selected at AP.41 PID Unit Sel.		
AP.45 PID P2–Gain	The PID controller's gain can be adjusted using the multi–function terminal. When a terminal is selected from In.65–69 and set to 24 (P Gain2), and if the selected terminal is entered, the gain set in AP.22 and AP.23 can be switched to the gain set in AP.45.		

NOTE: When the PID switch operation (switching from PID operation to general operation) enters the multi-function input, % values are converted to [Hz] values. The normal PID output, PID OUT, is unipolar, and is limited by AP.29 (PID Limit Hi) and AP.30 (PID Limit Lo). A calculation of 100.0% is based on the dr.20 (Max Freq) parameter setting.



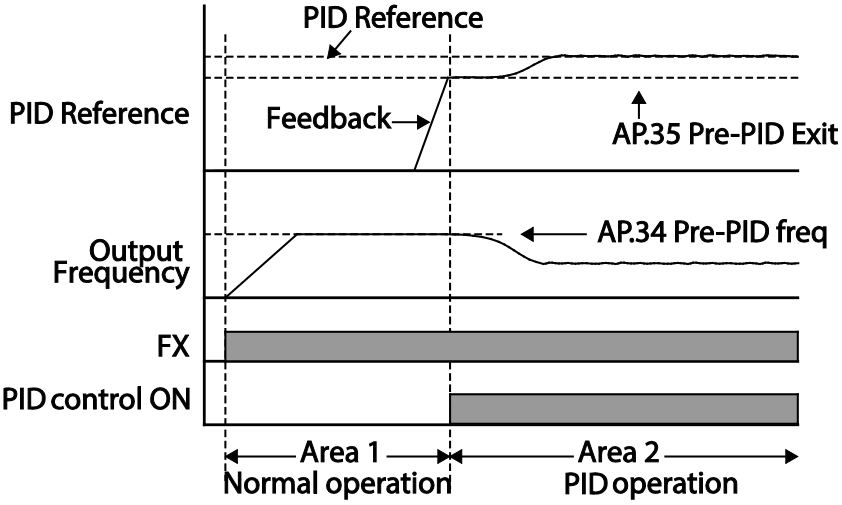
PID control block diagram

Pre–PID Operation

When an operation command is entered that does not include PID control, general acceleration occurs until the set frequency is reached. When the controlled variables increase to a particular point, the PID operation begins.

Pre–PID Operation Setting Details

Pr. Code	Description
AP.34 Pre–PID Freq	When general acceleration is required, the frequency up to general acceleration is entered. If Pre–PID Freq is set to 30Hz, the general operation continues until the control variable (PID feedback variable) set at AP. 35 is exceeded.
AP.35 Pre–PID Exit, AP.36 Pre–PID Delay	When the feedback variable of the PID controller is higher than the value set at AP. 35, the PID control operation begins. However, when a value is set for AP.36 (Pre–PID Delay) and a feedback variable less than the value set at AP.35 is maintained for a set amount of time, the "pre–PID Fail" fault trip will occur and the output will be blocked.

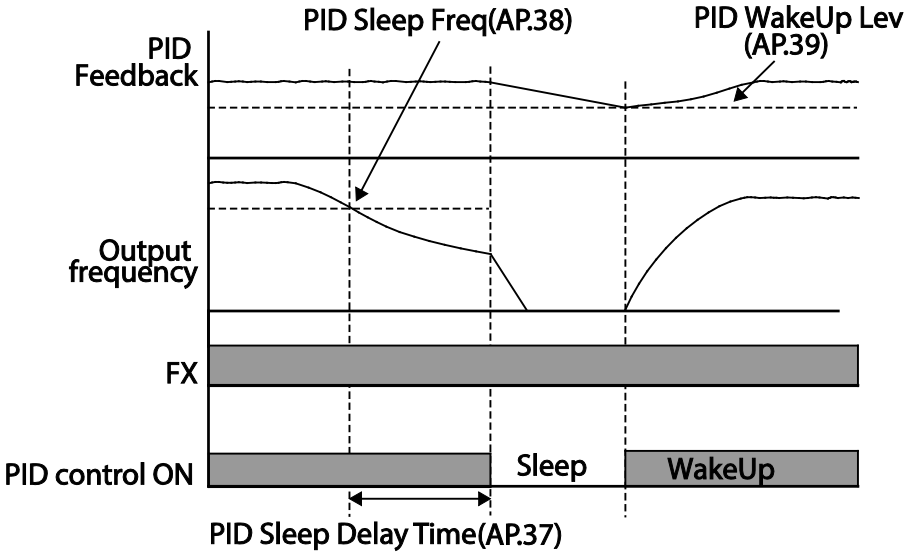


PID Operation Sleep Mode

If the operation continues at a frequency lower than the set condition for PID operation, the PID operation sleep mode starts. When PID operation sleep mode starts, the operation will stop until the feedback exceeds the parameter value set at AP.39 (PID WakeUp Lev).

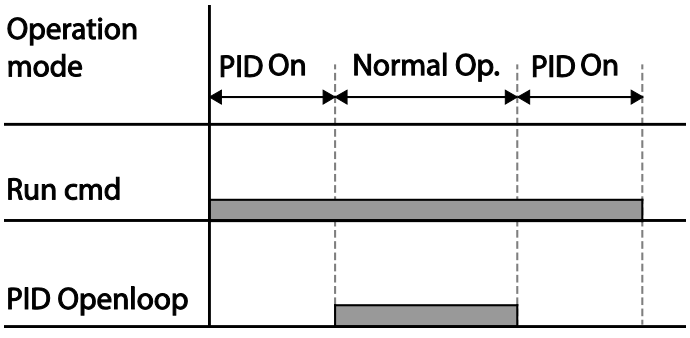
PID Operation Sleep Mode Setting Details

Pr. Code	Description
AP.37 PID Sleep DT, AP.38 PID Sleep Freq	If an operation frequency lower than the value set at AP.38 is maintained for the time set at AP.37, the operation stops and the PID operation sleep mode starts.
AP.39 PID WakeUp Lev, AP.40 PID WakeUp Mod	Starts the PID operation when in PID operation sleep mode. If AP. 40 is set to 0 (Below Level), the PID operation starts when the feedback variable is less than the value set as the AP. 39 parameter setting. If AP. 40 is set to 1 (Above Level), the operation starts when the feedback variable is higher than the value set at AP. 39. If AP. 40 is set to 2 (Beyond Level), the operation starts when the difference between the reference value and the feedback variable is greater than the value set at AP. 39.



PID Switching (PID Openloop)

When one of the multi–function terminals (In. 65–69) is set to 23 (PID Openloop) and is turned on, the PID operation stops and is switched to general operation. When the terminal turns off, the PID operation starts again.



Auto Tuning

The motor parameters can be measured automatically and can be used for auto torque boost or sensorless vector control.

Example – Auto Tuning Based on 1HP (0.75kW), 230V Motor

Pr. Group	Pr. Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
dr	14	Motor capacity	Motor Capacity	1	0.75 kW	0–15	–
	11	Motor pole number	Pole Number	4		2–48	–
	12	Rated slip speed	Rated Slip	40		0–3000	rpm
	13	Rated motor current	Rated Curr	3.6		1.0–1000.0	A
	14	Motor no–load current	Noload curr	1.6		0.5–1000.0	A
	15	Motor rated voltage	Rated Volt	220		170–480	V
	16	Motor efficiency	Efficiency	72		64–100	%
bA	20	Auto tuning	Auto Tuning	0	None	–	–
	21	Stator resistance	Rs	26.00		Depends on the motor setting	Ω
	22	Leakage inductance	Lsigma	179.4		Depends on the motor setting	mH
	23	Stator inductance	Ls	1544		Depends on the motor setting	mH
	24	Rotor time constant	Tr	145		25–5000	ms

Auto Tuning Default Parameter Setting

Motor Capacity kW (HP)		Rated Current (A)	No–load Current (A)	Rated Slip Frequency(Hz)	Stator Resistance(Ω)	Leakage Inductance (mH)
230V	0.2 (0.25)	1.1	0.8	3.33	14.0	40.4
	0.4 (0.5)	2.4	1.4	3.33	6.70	26.9
	0.75 (1.0)	3.4	1.7	3.00	2.600	17.94
	1.5 (2.0)	6.4	2.6	2.67	1.170	9.29
	2.2 (3.0)	8.6	3.3	2.33	0.840	6.63
	3.7 (5.0)	13.8	5.0	2.33	0.500	4.48
	5.5 (7.5)	21.0	7.1	1.50	0.314	3.19
	7.5 (10)	28.2	9.3	1.33	0.169	2.844
	11 (14.75)	40.0	12.4	1.00	0.120	1.488
	15 (20)	53.6	15.5	1.00	0.084	1.118
	18.5 (24.8)	65.6	19.0	1.00	0.068	0.819
	22 (29.5)	76.8	21.5	1.00	0.056	0.948

**When dr.9 (Control Mode) is set to 6 (PM Sensorless), auto tuning will configure the rated current and the stator resistor values by default.*

Motor Capacity kW (HP)		Rated Current (A)	No–load Current (A)	Rated Slip Frequency(Hz)	Stator Resistance(Ω)	Leakage Inductance (mH)
460V	0.2 (0.25)	0.7	0.5	3.33	28.00	121.2
	0.4 (0.5)	1.4	0.8	3.33	14.0	80.8
	0.75 (1.0)	2.0	1.0	3.00	7.81	53.9
	1.5 (2.0)	3.7	1.5	2.67	3.52	27.9
	2.2 (3.0)	5.0	1.9	2.33	2.520	19.95
	3.7 (5.0)	8.0	2.9	2.33	1.500	13.45
	5.5 (7.5)	12.1	4.1	1.50	0.940	9.62
	7.5 (10)	16.3	5.4	1.33	0.520	8.53
	11 (14.75)	23.2	7.2	1.00	0.360	4.48
	15 (20)	31.0	9.0	1.00	0.250	3.38
	18.5 (24.8)	38.0	11.0	1.00	0.168	2.457
	22 (29.5)	44.5	12.5	1.00	0.168	2.844
**When dr.9 (Control Mode) is set to 6 (PM Sensorless), auto tuning will configure the rated current and the stator resistor values by default.*						

Auto Tuning Parameter Setting Details

Pr. Code	Description		
bA.20 Auto Tuning	Select an auto tuning type and run it. Select one of the options and then press the [ENT] key to run the auto tuning.		
	Setting		Function
	0	None	Auto tuning function is not enabled. Also, if you select one of the auto tuning options and run it, the parameter value will revert back to "0" when the auto tuning is complete.
	1	All (rotating type)	Measures all motor parameters, including stator resistance (Rs), stator inductance (Lsigma), no–load current (Noload Curr), rotor time constant (Tr), etc., while the motor is rotating. As the motor is rotating while the parameters are being measured, if the load is connected to the motor spindle, the parameters may not be measured accurately. For accurate measurements, remove the load attached to the motor spindle. However, note that the rotor time constant (Tr) must be measured in a stopped position.
	2	All (static type)	Measures all parameters while the motor is in the stopped position. Measures stator resistance (Rs), stator inductance (Lsigma), no–load current (Noload Curr), rotor time constant (Tr), etc., while the motor is in the stopped position. As the motor is not rotating while the parameters are measured, the measurements are not affected when the load is connected to the motor spindle. However, when measuring parameters, do not rotate the motor spindle on the load side.
	3	Rs+Lsigma (rotating type)	Measures parameters while the motor is rotating. The measured motor parameters are used for auto torque boost or sensorless vector control.
	6	Tr (static type)	Measures the rotor time constant (Tr) with the motor in the stopped position and Control Mode (dr.9) is set to IM Sensorless.
	7	All (PM)	When dr.9 (Control Mode) is set to 6 (PM Sensorless), the motor parameters are measured in the stopped position. Check the motor's rating plate for motor specifications, such as the base frequency (dr.18), rated voltage (bA.15), pole number (bA.11). Then, perform auto tuning by setting bA.20 to 7 [All (PM)]. The auto tuning operation will configure the bA.21 (Rs), bA.28 [Ld (PM)], bA.29 [Lq (PM)], and bA.30 (PM Flux Ref) parameters.

Pr. Code	Description
bA.14 Noload Curr, bA.21 Rs–bA.24 Tr	Displays motor parameters measured by auto tuning. For parameters that are not included in the auto tuning measurement list, the default setting will be displayed.

CAUTION:

- *Perform auto tuning ONLY after the motor has completely stopped running.*
- *Before you run auto tuning, check the motor pole number, rated slip, rated current, rated voltage and efficiency on the motor's rating plate and enter the data. The default parameter setting is used for values that are not entered.*
- *When measuring all parameters after selecting 2 (All – static type) at bA.20: compared with rotation type auto tuning where parameters are measured while the motor is rotating, parameter values measured with static auto tuning may be less accurate. Inaccuracy of the measured parameters may degrade the performance of sensorless operation. Therefore, run static type auto tuning by selecting 2 (All) only when the motor cannot be rotated (when gearing and belts cannot be separated easily, or when the motor cannot be separated mechanically from the load).*
- *In PM synchronous motor sensorless control mode, check the motor's rating plate and enter the motor specifications, such as the base frequency, pole number, rated current and voltage, and efficiency, before performing auto tuning and detecting other motor parameters by setting bA.20 (Auto Tuning) to 7 [All (PM)]. The detected parameter values may not be accurate if the motor's base specifications are not entered.*

Sensorless Vector Control for Induction Motors

Sensorless vector control is an operation to carry out vector control without the rotation speed feedback from the motor but with an estimation of the motor rotation speed calculated by the drive. Compared to V/F control, sensorless vector control can generate greater torque at a lower level of current.

Pr. Group	Pr. Code	Name	LCD Display	Parameter Setting	Setting Range	Unit
dr	09	Control mode	Control Mode	4: IM Sensorless	–	–
	14	Motor capacity	Motor Capacity	Depends on the motor capacity	0–15	–
	18	Base frequency	Base Freq	60	30–400	Hz
bA	11	Motor pole number	Pole Number	4	2–48	–
	12	Rated slip speed	Rated Slip	Depends on the motor capacity	0–3000	Hz
	13	Rated motor current	Rated Curr	Depends on the motor capacity	1–1000	A
	14	Motor no–load current	Noload curr	Depends on the motor capacity	0.5–1000	A
	15	Rated motor voltage	Rated Volt	220/380/440/480	170–480	V
	16	Motor efficiency	Efficiency	Depends on the motor capacity	64–100	%
	20	Auto tuning	Auto Tuning	1: All	–	–

**Cn.23–32 and Cn.85–95 can be displayed only when Cn.20 is set to 1 (Yes).*

Pr. Group	Pr. Code	Name	LCD Display	Parameter Setting	Setting Range	Unit
	09	Pre–Excite time	PreExTime	1.0	0.0–60.0	s
	10	Pre–Excite amount	Flux Force	100.0	100.0–300.0	%
	20	Sensorless second gain display setting	SL2 G View Sel	1: Yes	0–1	–
	21	Sensorless speed controller proportional gain1	ASR–SL P Gain1	Depends on the motor capacity	0–5000	%
	22	Sensorless speed controller integral gain 1	ASR–SL I Gain1	Depends on the motor capacity	10–9999	ms
Cn	23*	Sensorless speed controller proportional gain 2	ASR–SL P Gain2	Depends on the motor capacity	1–1000	%
	24*	Sensorless speed controller integral gain 2	ASR–SL I Gain2	Depends on the motor capacity	1–1000	%
	25*	Sensorless speed controller integral gain 0	ASR–SL I Gain0	Depends on the motor capacity	10–9999	ms
	26*	Flux estimator proportional gain	Flux P Gain	Depends on the motor capacity	10–200	%
	27*	Flux estimator integral gain	Flux I Gain	Depends on the motor capacity	10–200	%
	28*	Speed estimator proportional gain	S–Est P Gain1	Depends on the motor capacity	0–32767	–
	29*	Speed estimator integral gain1	S–Est I Gain1	Depends on the motor capacity	100–1000	–
	30*	Speed estimator integral gain2	S–Est I Gain2	Depends on the motor capacity	100–10000	–
	31*	Sensorless current controller proportional gain	ACR SL P Gain	75	10–1000	–
	32*	Sensorless current controller integral gain	ACR SL I Gain	120	10–1000	–
	52	Torque controller output filter	Torque Out LPF	0	0–2000	ms
	53	Torque limit setting	Torque Lmt Src	0: Keypad–1	0–12	–
	54	Forward direction retrograde torque limit	FWD +Trq Lmt	180.0	0.0–200.0	%
	55	Forward direction regenerative torque limit	FWD –Trq Lmt	180.0	0.0–200.0	%
	56	Reverse direction regenerative torque limit	REV +Trq Lmt	180.0	0.0–200.0	%
	57	Reverse direction retrograde torque limit	REV –Trq Lmt	180.0	0.0–200.0	%
Cn	85*	Flux estimator proportional gain 1	Flux P Gain1	370	100–700	–
	86*	Flux estimator proportional gain 2	Flux P Gain2	0	0–100	–
	87*	Flux estimator proportional gain 3	Flux P Gain3	100	0–500	–
	88*	Flux estimator integral gain 1	Flux I Gain1	50	0–200	–
	89*	Flux estimator integral gain2	Flux I Gain2	50	0–200	–
	90*	Flux estimator integral gain 3	Flux I Gain3	50	0–200	–
	91*	Sensorless voltage compensation 1	SL Volt Comp1	30	0–60	–
	92*	Sensorless voltage compensation 2	SL Volt Comp2	20	0–60	–
	93*	Sensorless voltage compensation 3	SL Volt Comp3	20	0–60	–
	94*	Sensorless field weakening start frequency	SL FW Freq	95.0	80.0–110.0	%
	95*	Sensorless gain switching frequency	SL Fc Freq	2.00	0.00–8.00	Hz

**Cn.23–32 and Cn.85–95 can be displayed only when Cn.20 is set to 1 (Yes).*

CAUTION: For high–performance operation, the parameters of the motor connected to the drive output must be measured. Use auto tuning (bA.20 Auto Tuning) to measure the parameters before you run sensorless vector operation. To run high–performance sensorless vector control, the drive and the motor must have the same capacity. If the motor capacity is smaller than the drive capacity by more than two levels, control may be inaccurate. In that case, change the control mode to V/F control. When operating with sensorless vector control, do not connect multiple motors to the drive output.

Sensorless Vector Control Operation Setting for Induction Motors

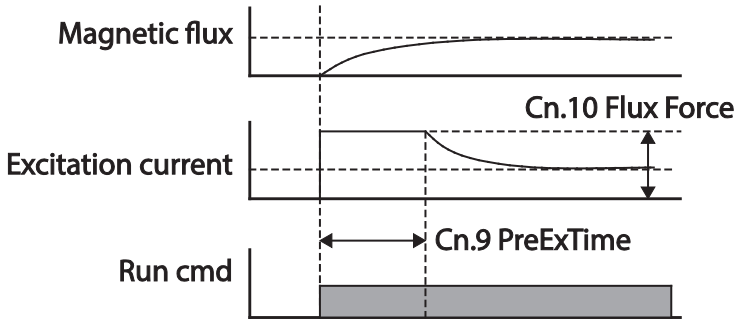
To run sensorless vector control operation, set dr.9 (Control Mode) to 4 (IM sensorless), select the capacity of the motor you will use at dr.14 (Motor Capacity), and select the appropriate codes to enter the rating plate information of the motor.

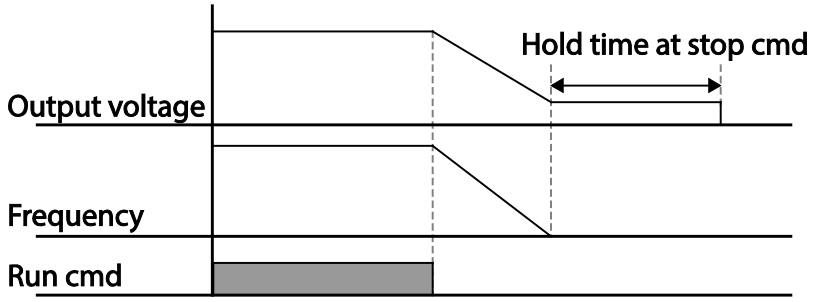
Pr. Code	Input (Motor Rating Plate Information)
dr.18 Base Freq	Base frequency
bA.11 Pole Number	Motor pole number
bA.12 Rated Slip	Rated slip
bA.13 Rated Curr	Rated current
bA.15 Rated Volt	Rated voltage
bA.16 Efficiency	Efficiency (when no information is on the rating plate, default values are used.)

After setting each code, set bA.20 (Auto tuning) to 1 (All – rotation type) or 2 (All – static type) and run auto tuning. Because rotation type auto tuning is more accurate than static type auto tuning, select 1 (All – rotation type) and run auto tuning if you can rotate the motor.

NOTE: Excitation Current
A motor can be operated only after magnetic flux is generated by current flowing through a coil. The power supply used to generate the magnetic flux is called the excitation current. The stator coil that is used with the drive does not have a permanent magnetic flux, so the magnetic flux must be generated by supplying an excitation current to the coil before operating the motor.

Sensorless Vector Control Operation Setting Details for Induction Motors

<table>
<tr><th>Pr. Code</th><th colspan="3">Description</th></tr>
<tr><td rowspan="4">Cn.20 SL2 G View Sel</td><td colspan="2">Setting</td><td>Function</td></tr>
<tr><td>0</td><td>No</td><td>Does not display sensorless (II) vector control gain code.</td></tr>
<tr><td>1</td><td>Yes</td><td>Allows the user to set various gains applied when the motor rotates faster than medium speed (approx. 1/2 of the base frequency) through sensorless (II) vector control.</td></tr>
<tr><td colspan="3">Codes available when setting to 1 (Yes): Cn.23 ASR–SL P Gain2/Cn.24 ASR–SL I Gain2/Cn.26 Flux P Gain/ Cn.27 Flux I Gain Gain3/Cn.28 S–Est P Gain1/Cn.29 S–Est I Gain1/Cn.30 S–Est I Gain1/Cn.31 ACR SL P Gain/ Cn.32 ACR SL I Gain</td></tr>
<tr><td>Cn.9 PreExTime</td><td colspan="3">Sets pre–excitation time. Pre–excitation is used to start the operation after performing excitation up to the motor's rated flux.</td></tr>
<tr><td>Cn.10 Flux Force</td><td colspan="3">Allows for the reduction of the pre–excitation time. The motor flux increases up to the rated flux with the time constant as shown in the following figure. To reduce the time taken to reach the rated flux, a higher motor flux base value than the rated flux must be provided. When the magnetic flux reaches the rated flux, the provided motor flux base value is reduced.
 
</td></tr>
</table>

Pr. Code	Description
Cn.11 Hold Time	Sets the zero–speed control time (hold time) in the stopped position. The output is blocked after zero–speed operation for a set period when the motor decelerates and is stopped by a stop command. 
Cn.21 ASR–SL P Gain1, ***Cn.22 ASR–SL I Gain1***	Changes the speed PI controller gain during sensorless vector control. For a PI speed controller, P gain is a proportional gain for the speed deviation. If speed deviation becomes higher than the torque the output command increases accordingly. As the value increases, the faster the speed deviation decreases. The speed controller I gain is the integral gain for speed deviation. It is the time taken for the gain to reach the rated torque output command while a constant speed deviation continues. The lower the value becomes, the faster the speed deviation decreases. This setting applies to speed ranges from 3-30Hz
Cn.23 ASR–SL P Gain2, ***Cn.24 ASR–SL I Gain2***	Appears only when 1 (Yes) is selected for Cn.20 (SL2 G view Sel). The speed controller gain can be increased to more than the medium speed for sensorless vector control. Cn.23 ASR–SL P Gain2 is set as a percentage of the low speed gain Cn.21 ASR–SL P Gain1 – if P Gain 2 is less than 100.0%, the responsiveness decreases. For example, if Cn.21 ASR–SL P Gain1 is 50.0% and Cn.23 ASR–SL P Gain2 is 50.0%, the actual middle speed or faster speed controller P gain is 25.0%. Cn.24 ASR–SL I Gain2 is also set as a percentage of the Cn.22 ASR–SL I Gain1. For I gain, the smaller the I gain 2 becomes, the slower the response time becomes. For example, if Cn.22 ASR–SL I Gain1 is 100ms and Cn.24 ASR–SL I Gain2 is 50.0%, the middle speed or faster speed controller I gain is 200 ms. The controller gain is set according to the default motor parameters and Acc/Dec time. This setting applies to speed ranges from above 30Hz
Cn.25	Integral gain to keep the output current from increasing up to overload current level (150%). This parameter only applies for drives of 4Kw(5HP) or less and to speed ranges from 0-3Hz.
Cn.26 Flux P Gain, ***Cn.27 Flux I Gain,*** ***Cn.85–87 Flux P Gain13,*** ***Cn.88–90 Flux I Gain1–3***	Sensorless vector control requires the rotor flux estimator. For the adjustment of flux estimator gain, refer to "Sensorless Vector Control Operation Guide for Induction Motors" on page 4–153.
Cn.28 S–Est P Gain1, ***Cn.29 S–Est I Gain1,*** ***Cn.30 S–Est I Gain2***	Speed estimator gain for sensorless vector control can be adjusted. To adjust speed estimator gain, refer to "Sensorless Vector Control Operation Guide for Induction Motors" on page 4–153.
Cn.31 ACR SL P Gain, ***Cn.32 ACR SL I Gain***	Adjusts the P and I gains of the sensorless current controller. For the adjustment of sensorless current controller gain, refer to "Sensorless Vector Control Operation Guide for Induction Motors" on page 4–153.

<table>
<tr><th>Pr. Code</th><th colspan="3">Description</th></tr>
<tr><td rowspan="11">Cn.53 Torque Lmt Src</td><td colspan="3">Select a type of torque limit setting, using the keypad, terminal block analog input (V1 and I2) or communication power. When setting torque limit, adjust the torque size by limiting the speed controller output. Set the retrograde and regenerative limits for forward and reverse operation.</td></tr>
<tr><td colspan="2">Setting</td><td>Function</td></tr>
<tr><td>0</td><td>Keypad–1</td><td rowspan="2">Sets the torque limit with the keypad.</td></tr>
<tr><td>1</td><td>Keypad–2</td></tr>
<tr><td>2</td><td>V1</td><td rowspan="3">Sets the torque limit with the analog input terminal of the terminal block.</td></tr>
<tr><td>4</td><td>V2</td></tr>
<tr><td>5</td><td>I2</td></tr>
<tr><td>6</td><td>Int 485</td><td>Sets the torque limit with the communication terminal of the terminal block.</td></tr>
<tr><td>8</td><td>FieldBus (Ethernet)</td><td>Sets the torque limit with the FieldBus (Ethernet) communication option.</td></tr>
<tr><td>9</td><td>UserSeqLink</td><td>This enters the torque reference by linking the common area with the user sequence output.</td></tr>
<tr><td>12</td><td>Pulse</td><td>Sets the torque limit with the pulse input of the terminal block.</td></tr>
<tr><td colspan="3">The torque limit can be set up to 200% of the rated motor torque.</td></tr>
<tr><td>Cn.54 FWD +Trq Lmt</td><td colspan="3">Sets the torque limit for forward retrograde (motoring) operation.</td></tr>
<tr><td>Cn.55 FWD –Trq Lmt</td><td colspan="3">Sets the torque limit for forward regenerative operation.</td></tr>
<tr><td>Cn.56 REV +Trq Lmt</td><td colspan="3">Sets the torque limit for reverse regenerative operation.</td></tr>
<tr><td>Cn.57 REV –Trq Lmt</td><td colspan="3">Sets the torque limit for reverse retrograde (motoring) operation.</td></tr>
<tr><td>In.2 Torque at 100%</td><td colspan="3">Sets the maximum torque. For example, if In.2 is set to 200% and an input voltage (V1) is used, the torque limit is 200% when 10V is entered. However, when the VI terminal is set up with the factory default setting and the torque limit setup uses a method other than the keypad, check the parameter settings in the monitor mode. In the Config Mode CNF.21–23 (only displayed when using LCD keypad), select 21(Torque limit).</td></tr>
<tr><td>Cn.91–93 SL Volt Comp1–3</td><td colspan="3">Adjust output voltage compensation values for sensorless vector control. For output voltage compensation, refer to "Sensorless Vector Control Operation Setting for Induction Motors" on page 4–150.</td></tr>
<tr><td>Cn.52 Torque Out LPF</td><td colspan="3">Sets the time constant for torque command by setting the torque controller output filter.</td></tr>
</table>

CAUTION: Adjust the controller gain according to the load's characteristics. However, the motor can overheat or the system may become unstable depending on the controller gain settings.

NOTE: Speed controller gain can improve the speed control waveform while monitoring the changes in speed. If speed deviation does not decrease quickly, increase the speed controller P gain or decrease I gain (time in ms). However, if the P gain is increased too high or I gain is decreased too low, severe vibration may occur. If oscillation occurs in the speed waveform, try to increase I gain (ms) or reduce P gain to adjust the waveform.

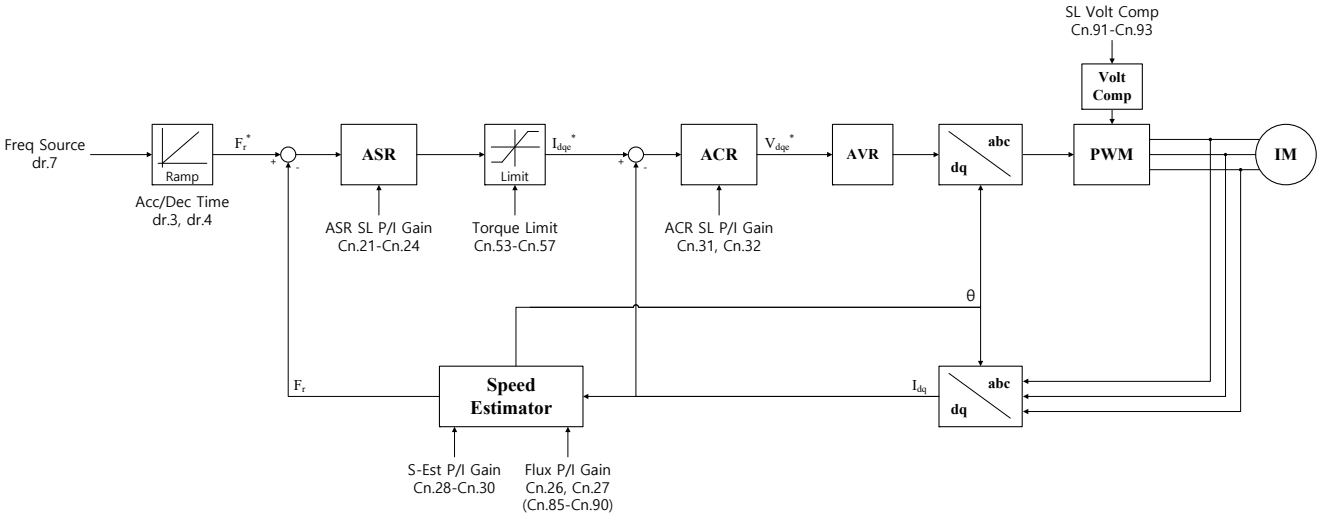
Sensorless Vector Control Operation Guide for Induction Motors

Problem	Relevant function code	Troubleshooting
The amount of starting torque is insufficient.	bA.24 Tr Cn.9 PreExTime Cn.10 Flux Force Cn.31 ACR SL P Gain Cn.54–57 Trq Lmt Cn.93 SL Volt Comp3	Set the value of Cn. 90 to be more than 3 times the value of bA.24 or increase the value of Cn.10 by increments of 50%. If the value of Cn.10 is high, an overcurrent trip at start can occur. In this case, reduce the value of Cn.31 by decrements of 10.
		Increase the value of Trq Lmt (Cn.54–57) by increments of 10%.
		Increase the value of Cn.93 by increments of 5.
The output frequency is higher than the base frequency during no–load operation at low speed (10Hz or lower).	Cn.91 SL Volt Comp1	Decrease the value of Cn.91 by decrements of 5.
The motor hunts or the amount of torque is not sufficient while the load is increasing at low speed (10Hz or lower).	Cn.4 Carrier Freq Cn.21 ASR–SL P Gain1 Cn.22 ASR–SL I Gain1 Cn.93 SL Volt Comp3	If the motor hunts at low speed, increase the value of Cn.22 by increments of 50m/s, and if hunting does not occur, increase the value of Cn.21 to find the optimal operating condition.
		If the amount of torque is insufficient, increase the value of Cn.93 by increments of 5.
		If the motor hunts or the amount of torque is insufficient in the 5–10 Hz range, decrease the value of Cn.4 by increments of 1kHz (if Cn.4 is set to exceed 3kHz).
The motor hunts or overcurrent trip occurs in regenerative load at low speed (10 Hz or lower).	Cn.92 SL Volt Comp2 Cn.93 SL Volt Comp3	Increase the value of Cn.92–93 by increments of 5 at the same time.
Over voltage trip occurs due to sudden acceleration/deceleration or sudden load fluctuation (with no brake resistor installed) at mid speed (30Hz or higher).	Cn.24 ASR–SL I Gain2	Decrease the value of Cn.2 by decrements of 5%.
Over current trip occurs due to sudden load fluctuation at high speed (50 Hz or higher).	Cn.54–57 Trq Lmt Cn.94 SL FW Freq	Decrease the value of Cn.54–57 by decrements of 10% (if the parameter setting is 150% or higher).
		Increase/decrease the value of Cn.94 by increments/decrements of 5% (set below 100%).
The motor hunts when the load increases from the base frequency or higher.	Cn.22 ASR–SL I Gain1 Cn.23 ASR–SL I Gain2	Increase the value of Cn.22 by increments of 50m/s or decrease the value of Cn.24 by decrements of 5%.
The motor hunts as the load increases.	Cn.28 S–Est P Gain1 Cn.29 S–Est I Gain1	At low speed (10Hz or lower), increase the value of Cn.29 by increments of 5.
		At mid speed (30 Hz or higher), increase the value of Cn.28 by increments of 500. If the parameter setting is too extreme, over current trip may occur at low speed.
The motor speed level decreases.	bA.20 Auto Tuning	Select 6. Tr (static type) from bA.20 and run tuning. Then Select 1 from bA.20 and run tuning.
**Hunting: Symptom of irregular vibration of the equipment.*		

Sensorless Vector Control Block Diagram

IM Sensorless Vector Control (IMSVC) – Speed Control

When dr.9 is set to 4: IM Sensorless & dr.10 is set to 0, the IM Sensorless Speed Control diagram is as shown here:



Sensorless Vector Control for PM (Permanent–Magnet) Synchronous Motors

Sensorless vector control is an operation that carries out vector control without rotation speed feedback from the motor but, instead, with an estimation of the motor rotation speed calculated by the drive.

Pr. Grp	Pr. #	Name	LCD Display	Parameter Setting	Setting Range	Unit
dr	09	Control mode	Control Mode	6: PM Sensorless	–	–
	14	Motor capacity	Motor Capacity	Depends on the motor capacity	0–15	–
	18	Base frequency	Base Freq	Depends on the PM motor capacity	30–180	Hz
	20	Maximum frequency	Max Freq	Depends on the PM motor capacity	40–180	Hz
bA	11	Motor pole number	Pole Number	4	2–48	–
	13	Rated motor current	Rated Curr	Depends on the motor capacity	1–1000	A
	15	Motor–rated voltage	Rated Volt	220/380/440/480	170–480	V
	16	Motor efficiency	Efficiency	Depends on the motor capacity	64–100	%
	19	Motor input voltage	AC Input Volt	220/380	170–480	–
	20	Auto tuning	Auto Tuning	7	All (PM)	–
	32	Q–axis inductance scale	Lq (PM) Scale	100%	50–150	%
	34	Auto tuning level for Ld and Lq	Ld, Lq Tune Lev	33.3%	20.0–50.0	%
	35	Auto tuning frequency for Ld and Lq	Ld, Lq Tune Hz	100.0%	80.0–150.0	%
Cn	12	PM speed controller P gain 1	ASR P Gain 1	100	0–5000	–
	13	PM speed controller I gain 1	ASR I Gain 1	150	0–5000	–
	15	PM speed controller P gain 2	ASR P Gain 2	100	0–5000	–
	16	PM speed controller I gain 2	ASR I Gain 2	150	0–9999	–
	33	PM D–axis back–EMF estimated gain	PM EdGain Perc	100.0	0–300.0	%
	34	PM Q–axis back–EMF estimated gain	PM EqGain Perc	100.0	0–300.0	%
	35	Initial pole position estimation retry	PD Repeat Num	2	0–10	–
	36	Initial pole position estimation interval	Pulse Interval	20	1–100	ms
	37	Initial pole position estimation pulse current	Pulse Curr %	15	10–100	%
	38	Initial pole position estimation pulse voltage	Pulse Volt %	500	100–4000	–
	39	PM dead–time range	PMdeadBand Per	100.0	50.0–200.0	%
	40	PM dead–time voltage	PMdeadVolt Per	100.0	50.0–200.0	%
	41	PM speed estimator proportional gain	PM SpdEst Kp	100	0–32000	–
	42	PM speed estimator integral gain	PM SpdEst Ki	10	0–32000	–
	43	PM speed estimator proportional gain 2	PM SpdEst Kp 2	300	0–32000	–
	44	PM speed estimator integral gain 2	PM SpdEst Ki 2	30	0–32000	–
	45	Speed estimator feedforward high speed range	PM Flux FF %	300	0–1000	%
	46	Initial pole position estimation type	Init Angle Sel	1: Angle Detect	0–2	0–2
	48	Current controller P gain	ACR P Gain	1200	0–10000	–
	49	Current controller I gain	ACR I Gain	120	0–10000	–
	50	Voltage controller limit	V Con HR	10.0%	0–1000	%
	51	Voltage controller I gain	V Con Ki	10.0%	0–20000	%
	52	Torque controller output filter	Torque Out LPF	0	0–2000	msec
	53	Torque limit source	Torque Lmt Src	0	Keypad–1	0–12
	54	FWD reverse torque limit	FWD +Trq Lmt	180.0	0.0–200.0	%
	55	FWD regenerative torque limit	FWD –Trq Lmt	180.0	0.0–200.0	%
	56	REV regenerative torque limit	REV +Trq Lmt	180.0	0.0–200.0	%
	57	REV reverse torque limit	REV –Trq Lmt	180.0	0.0–200.0	%

CAUTION: For high–performance operation, the parameter values of the motor connected to the drive output must be estimated. Configure the motor–related Basic function group parameters by entering the motor specification values on the rating plate. Then, perform auto tuning by setting bA. 20 (Auto Tuning) to 7 [All (PM)] to automatically measure other parameters before operating a PM synchronous motor in sensorless vector control mode. For high–performance PM sensorless vector control, the drive and the motor must have the same capacity. The drive control may be inaccurate if the motor capacity and the drive capacity do not match. In sensorless vector control mode, do not connect multiple motors to the drive output.

Detecting the Initial Pole Position

Initial pole position detection is a process to match the rotor position calculated by the drive and the actual rotor position in a motor. In a permanent–magnet (PM) synchronous motor, rotor flux is generated from the permanent magnet attached to the rotor. Therefore, to run the motor in vector control mode, the exact rotor position (flux position) must be detected for accurate control of the torque generated by the motor.

At Cn. 46 (InitAngle Sel), select the type of initial pole position detection.

When Cn.46 is set to 0 (None), the motor is operated according to the pole position estimated by the drive's internal algorithm, instead of actually detecting the physical position of the rotor pole.

When Cn.46 is set to 1 (Angle Detect), the motor is operated according to the pole position detected by changes in the current. The voltage pulse input is used to detect the pole position and results in a small amount of noise at motor startup.

When Cn.46 is set to 2 (Alignment), the drive forcefully aligns the rotor position by supplying DC current for a certain period of time.

Pr. Group	Pr. Code	Name	LCD display	Setting		Setting range	Unit
Cn	35	Pole position detection retry count	PD Repeat Num	1		0–10	–
	36	Pole position detection interval	Pulse Interval	20		1–100	Ms
	37	Pole position detection pulse current	Pulse Curr %	15		10–100	%
	38	Pole position detection pulse voltage	Pulse Volt %	500		100–4000	%
	46	Pole position detection type	Init Angle Sel	0	None	0–2	–
				1	Angle Detect		
				2	Alignment		

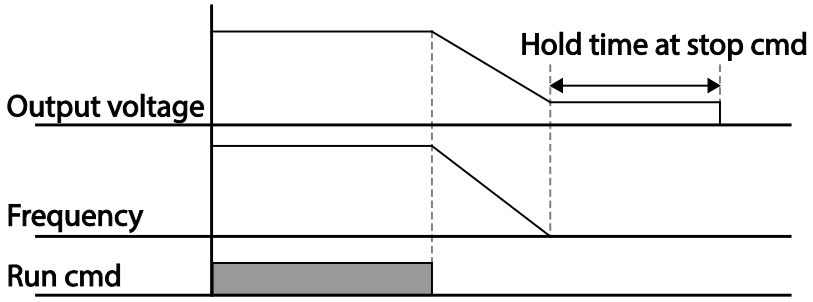
Sensorless Vector Control Mode Settings for PM Synchronous Motors

To operate a PM synchronous motor in sensorless vector control mode, set dr.9 (Control Mode) to 6 (PM Sensorless), select the motor capacity at dr.14 (Motor Capacity), and enter the appropriate codes in the Basic (bA) group with the motor specification values found on the motor's rating plate. If a specific motor capacity does not exist in the setting options, select a higher motor capacity that is closest to the actual motor capacity.

Pr. Code	Input Values (Motor's Rating Plate Information)
dr.18 Base Freq	Base frequency
dr.20 Max Freq	Maximum frequency
bA.11 Pole Number	Motor pole number
bA.13 Rated Curr	Rated current
bA.15 Rated Volt	Rate voltage
bA.16 Efficiency	Efficiency
bA.19 AC Input Volt	Input power voltage

After entering the codes, set bA.20 (Auto tuning) to 7 [All(PM)] and perform a static auto tuning operation. When auto tuning is complete, the bA.21 (Rs), bA.28 Ld (PM), bA. 29 Lq (PM), and bA. 30 (PM Flux Ref) parameters are automatically measured and saved.

Sensorless Vector Control Operation Setting Details

Pr. Code	Description
Cn.4 Carrier Freq	Sets the PWM interrupter cycle and sampling frequency cycle for a PM synchronous motor operation in sensorless vector control mode. The default carrier frequency is set at 5 kHz, and the setting range is 2–10 kHz.
Cn.11 Hold Time	Sets the zero–speed control time (hold time) in the stopped position. The output is blocked after zero–speed operation for a set period when the motor decelerates and is stopped by a stop command. 
Cn.12 ASR P Gain1, ***Cn.13 ASR I Gain1*** ***Cn.15 ASR P Gain2*** ***Cn.16 ASR I Gain2***	Changes the speed PI controller gain during a PM synchronous motor operation in sensorless vector control mode. For a PI speed controller, P gain is a proportional gain for the speed deviation. If the speed deviation becomes greater than the torque, the output command will increase accordingly. The higher the value becomes, the faster the speed deviation will decrease. The speed controller I gain is the integral gain for speed deviation. It is the time taken for the gain to reach the rated torque output command while constant speed deviation continues. The lower the value becomes, the faster the speed deviation will decrease. As the motor inertia varies by motor, the gain values should be changed according to the motor speeds. Cn.12 and Cn. 13 set the low speed P/I controller gain values, while Cn.15 and Cn.16 set the high speed P/I controller gain values, so that an appropriate gain value can be used for different motor speeds.
Cn.33 PM EdGain Perc, ***Cn.34 PM EqGain Perc***	To ensure that the back–EMF with rotor position information can be appropriately estimated during a PM synchronous motor operation in sensorless vector control mode, set these values as a percentage of the proportional gain, which is designed to have stable estimator polarity. Higher values result in faster responses, with higher chances of increased motor vibration. Excessively low values may result in motor startup failure due to slow response rate.

<table>
<tr><th>Pr. Code</th><th colspan="3">Description</th></tr>
<tr><td>Cn.41 PM SpdEst Kp,
Cn.42 PM SpdEst Ki
Cn.43 PM SpdEst Kp2
Cn.44 PM SpdEst Ki2</td><td colspan="3">Set these parameters to change the speed estimator gain during a PM synchronous motor operation in sensorless vector control mode.
If fault trips occur or excessive oscillation is observed at low speeds, decrease the value at Cn.41 in 10% decrements until the motor operates stably.
If ripples occur during normal operation, increase the value at Cn. 42.
The values at Cn.43 and Cn.44 are used for low speed operations in 200V motors.</td></tr>
<tr><td>Cn.39 PMdeadBand Per
Cn.40PMdeadVolt Per</td><td colspan="3">Sets the output compensation values during a PM synchronous motor operation in sensorless vector control mode.
If the motor fails to operate at low speeds at or below 5% of the rated motor speed, increase the values set at Cn.39 and Cn.40 by 10% increments. Decrease the values in 10% decrements if a clanking noise occurs at motor startup and motor stop.</td></tr>
<tr><td>Cn.45 PM Flux FF %</td><td colspan="3">Sets the high–speed portion of the feed forward rate against the back–EMF during a PM synchronous motor operation in sensorless vector control mode. Feed forwarding enhances operation of the speed estimator. Increase the value at Cn.45 in 10% increments to suppress motor oscillation under load. A fault trip may occur if this value is set too high.</td></tr>
<tr><td>Cn.48 ACR P–Gain
Cn.49 ACR I–Gain</td><td colspan="3">Sets the gain values for the PI current controller in a synchronous motor.
The P gain is the proportional gain for the current deviation. The current deviation decreases faster with higher values, as the deviation in voltage output command increases with increased deviation.
The I gain is the integral gain for the current deviation. Deviation in normal operation decreases with higher values.
However, the gain values are limited by the carrier frequency. A fault trip may occur due to interference if you set the gain values too high.</td></tr>
<tr><td rowspan="11">Cn.53 Torque Lmt Src</td><td colspan="3">Select a source for torque limit input: Keypad, terminal block analog input (V1 and I2), or input via network communication.
The torque limit value is used to adjust the torque reference size by limiting the speed controller output. The reverse and regenerative torque limits may be set for operations in the forward or reverse direction.</td></tr>
<tr><td>Setting</td><td colspan="2">Function</td></tr>
<tr><td>0</td><td>Keypad–1</td><td rowspan="2">Sets the torque limit via the keypad.</td></tr>
<tr><td>1</td><td>Keypad–2</td></tr>
<tr><td>2</td><td>V1</td><td rowspan="3">Sets the torque limit via the analog input terminals of the terminal block.</td></tr>
<tr><td>4</td><td>V2</td></tr>
<tr><td>5</td><td>I2</td></tr>
<tr><td>6</td><td>Int 485</td><td>Sets the torque limit via the communication terminal of the terminal block.</td></tr>
<tr><td>8</td><td>FieldBus (Ethernet)</td><td>Sets the torque limit with the FieldBus (Ethernet) communication option.</td></tr>
<tr><td>9</td><td>UserSeqLink</td><td>Sets the torque limit with a user sequence output. The torque reference is received via the common area addresses.</td></tr>
<tr><td>12</td><td>Pulse</td><td>Sets the torque limit with the pulse input of the terminal block.</td></tr>
<tr><td colspan="3">The torque limit can be set up to 200% of the rated motor torque.</td></tr>
<tr><td>Cn.54 FWD +Trq Lmt</td><td colspan="3">Sets the reverse torque limit for forward operation.</td></tr>
<tr><td>Cn.55 FWD –Trq Lmt</td><td colspan="3">Sets the regenerative torque limit for forward operation.</td></tr>
<tr><td>Cn.56 REV +Trq Lmt</td><td colspan="3">Sets the regenerativese torque limit for reverse operation.</td></tr>
<tr><td>Cn.57 REV –Trq Lmt</td><td colspan="3">Sets the reverse torque limit for reverse operation.</td></tr>
<tr><td>In.2 Torque at 100%</td><td colspan="3">Sets the maximum torque. For example, if In.2 is set to 200% and an input voltage (V1) is used, the torque limit will be 200% when 10V is entered. However, when the V1 terminal is set to the factory default setting and the torque limit input source is any device other than the keypad, check the parameter settings in Monitor mode. Set CnF.21–23 (only displayed when an LCD keypad is used) to 21 (Torque limit).</td></tr>
<tr><td>Cn.52 Torque Out LPF</td><td colspan="3">Sets the time constant for torque command by setting the torque controller output filter.</td></tr>
</table>

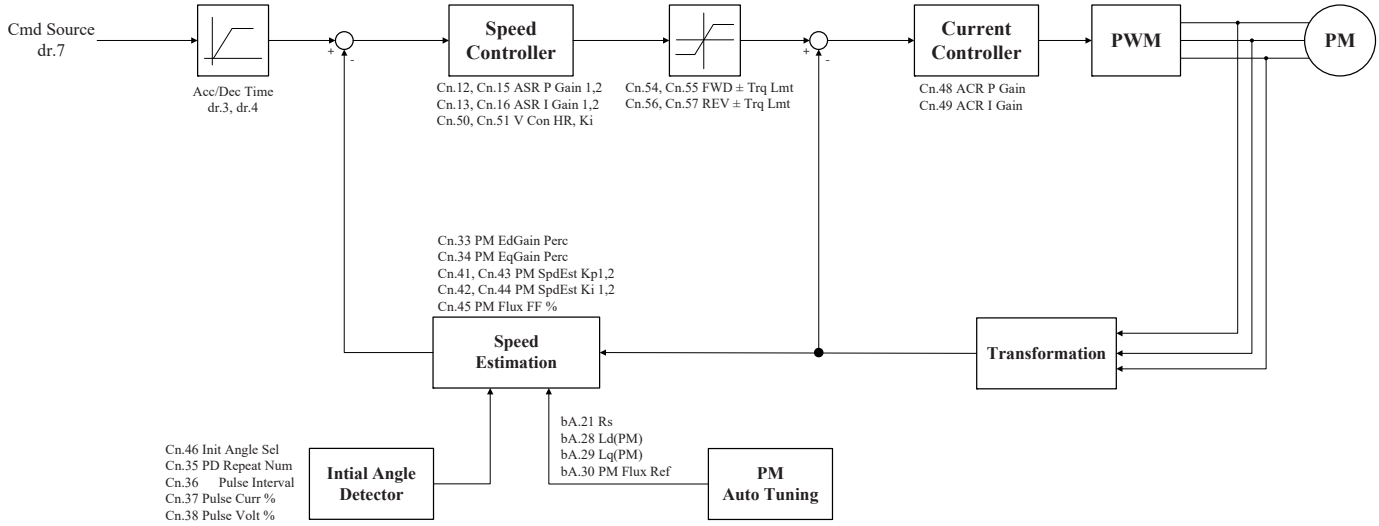
CAUTION: Adjust the controller gain according to the load's characteristics. However, the motor can overheat or the system can become unstable depending on the controller gain settings.

NOTE: Speed controller gain can improve the speed control waveform while monitoring the changes in speed. If the speed deviation does not decrease fast enough, increase the speed controller P gain or decrease I gain (time in ms). However, if the P gain value is increased too much or the I gain value is decreased too much, severe vibrations may occur. If oscillation occurs in the speed waveform, try to increase the I gain (ms) or reduce the P gain to adjust the waveform.

Sensorless Vector Control Block Diagram

PM Sensorless Vector Control (PMSVC) – Speed Control

When dr.9 is set to 6: the PM Sensorless Speed Control diagram is as shown here:



Guidelines for Running a PM Synchronous Motor in Sensorless Vector Control Mode

Problem	Relevant function code	Troubleshooting
Starting torque is insufficient.	Cn.48 ACR P–Gain Cn.39 PMdeadBand Per Cn.40Note1) PMdeadVolt Per	If an overcurrent trip occurs at startup, try decreasing the value at Cn.48 in 10% decrements. Try increasing the value at Cn.39 or Cn.40 in 10% increments.
The motor hunts when starting up.	Cn.40 PMdeadVolt Per	Try decreasing the value at Cn.40 in 10% decrements.
The motor hunts with regenerative load at low speed (10Hz or lower), or an "OCT" fault trip occurs.	Cn.40 PMdeadVolt Per	Try increasing the value at Cn.40 in 10% increments.
The motor hunts* or the torque is not sufficient while the load is increasing at low speed (10Hz or lower).	Cn.4 Carrier Freq Cn.12 ASR P Gain 1 Cn.13 ASR I Gain 1	If the motor hunts at low speeds, try increasing the value at Cn.13 in 50 msec increments. If the motor does not hunt, try increasing the value at Cn.12 in 10% increments until the motor runs in an optimal operation condition. If the motor hunts and the torque is not sufficient at 5–10 Hz speed range, and if the carrier frequency at Cn.4 is set to more than 3 kHz, try decreasing the value in 1kHz decrements.
The motor hunts excessively during no–load operation when rated current is supplied to the motor.	Cn.12 ASR P Gain 1 Cn.13 ASR I Gain 1 Cn.15 ASR P Gain 2 Cn.16 ASR I Gain 2	Try decreasing the speed controller gains at Cn. 12–16 in 30% decrements.
The value at bA.30 (PM Flux Ref) becomes "0" after performing an auto tuning operation by setting bA. 20 to 7 [All (PM)].	bA.11 Pole Number bA.15 Rated Volt dr.18 Base Freq	Refer to the motor's rating plate and set the pole number at bA.11 (Pole Number), or enter a calculated pole number: Pole Number = (120 x BaseFreq/BaseRPM) Refer to the motor's rating plate and set the rated voltage and base frequency at bA.15 (Rated Volt) and dr.18 (Base Freq), and then run auto tuning again by setting bA.20 (Auto Tuning) to 7 [All (PM)].
Fault trips occur after a static auto tuning.	bA.21 Rs bA.28 Ld (PM) bA.29 Lq (PM) bA.30 PM Flux Ref	Motor operation may fail if a static PM auto tuning result is not accurate. Refer to the motor's rating plate and set the motor–related parameters again.
"OVT" occurs due to abrupt acceleration, deceleration, or massive load change while the motor is operated at mid–speed (above 30Hz). Note2)	Cn.16 ASR I Gain 2	Try decreasing the value at Cn.16 in 5% decrements.
Speed variation occurs during an operation at rated motor speed, or during an overloaded high speed operation.	Cn.45 PM Flux FF % Cn.50 V Con HR Cn.51 V Con Ki	If the motor is operated at the rated speed, try decreasing the value at Cn.50 in 5% increments. If the motor response is slow, try increasing the value at Cn.51 in 5% increments (or, try increasing the value at Cn.45 in 100% increments).
"OC1" fault trip or jerking occurs during a high speed operation.	Cn.41 PM SpdEst Kp Cn.42 PM SpdEst Ki	Try increasing the value at Cn. 41 in increments of 10 and the value at Cn.42 in increments of 1. Note that a fault trip may occur if the values at Cn. 41 and Cn.42 are set too high.
Jerking occurs during a low speed operation.	Cn.13 ASR I Gain 1	Try increasing the value at Cn.13 (low speed range speed controller I gain) to eliminate jerking.
A "clanking" noise is heard at the beginning of startup or during deceleration.	Cn.12 ASR P Gain 1 Cn.13 ASR I Gain 1 Cn.40 PMdeadVolt Per	Try increasing the values at Cn.12 and Cn.13 in 10% increments, or try decreasing the value at Cn.40 in 10% decrements.
The motor cannot reach the speed reference when it is operated at or above the rated speed, or when the acceleration is not responsive.	Cn.50 V Con HR Cn.51 V Con Ki	Try increasing the value at Cn.50 in 1% increments if the motor cannot reach the speed reference. Try increasing the value at Cn.51 in 10% increments if the motor acceleration is not responsive.
"OC1" trip occurs after an abrupt regenerative load (over 100%).	Cn.12 ASR P Gain 1 Cn.13 ASR I Gain 1	Try decreasing the values at Cn.12 and Cn.13 in 10% decrements.

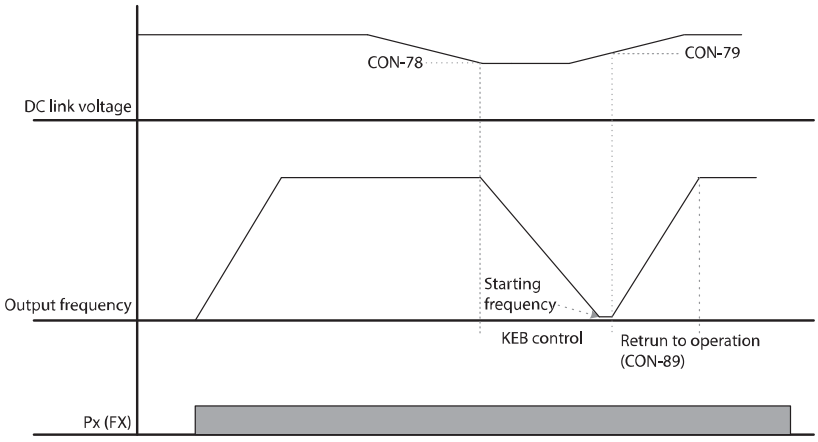
Problem	Relevant function code	Troubleshooting
The motor jerks during acceleration.	Cn.42 PM SpdEst Ki	Try increasing the speed estimator proportional gain at Cn.42 in increments of 5.
A massive current rises when the motor is stopped during a 20: 1 speed startup.	Cn.13 ASR I Gain 1	Try increasing the value at Cn. 13 in 10% increments.
An oscillation occurs when an abrupt load is applied to the motor during a low speed operation.	Cn.41 PM SpdEst Kp Cn.42 PM SpdEst Ki	Try increasing the values at Cn. 41 and Cn.42 in 10% increments.
During a PM speed search, the speed search stops at around 20% of the base frequency, and the motor is stopped and starts again after a massive current rises.	Cn.69 SS Pulse Curr	Try decreasing the value at Cn.69 in 5% decrements.
During a high–speed operation in PM control mode utilizing the kinetic energy buffering, a massive current rises at around 20% of the base frequency, the motor is stopped, and it fails to start.	Cn.78 KEB Start Lev Cn.79 KEB Stop Lev Cn.80 KEB P Gain Cn.81 KEB I Gain	Try increasing the values at Cn.78 and Cn.79 in 5% increments, or try doubling the gain values at Cn.80 and Cn. 81.
1. When the motor is overloaded, the maximum torque limit current is supplied to the motor at startup, and the motor fails to operate due to an drive overload fault trip. ***2. Speed search fails when the a load exceeding the rated load is applied to the motor at each speed section, or a current equal to or exceeding 150% of the rated current is supplied to the motor.***	bA.29 Lq (PM)	This happens when the Lq parameter value is decreasing due to certain causes, such as self–saturation. Try increasing the value (100%) at bA.32 in 5% increments.
A fault trip occurs when the motor tries to start up or accelerate from a free run at certain speed range.	Cn.71 Speed Search	During a PM synchronous motor operation in sensorless vector mode, the motor starts up after the initial pole position detection is made. To accelerate the motor in a free–run state, enable speed search at acceleration by setting bit 0 (0001) at Cn.71 (Speed Search).
During a low speed operation, the output speed search becomes unstable when a massive load exceeding the rated load is abruptly applied to the motor.	Cn.13 ASR I Gain 1 Cn.40 PMdeadVolt Per	The motor control may become unstable due to input voltage deviation during a low–speed operation with low voltage input. Try decreasing the values at Cn.31 and Cn.40 in 10% decrements.

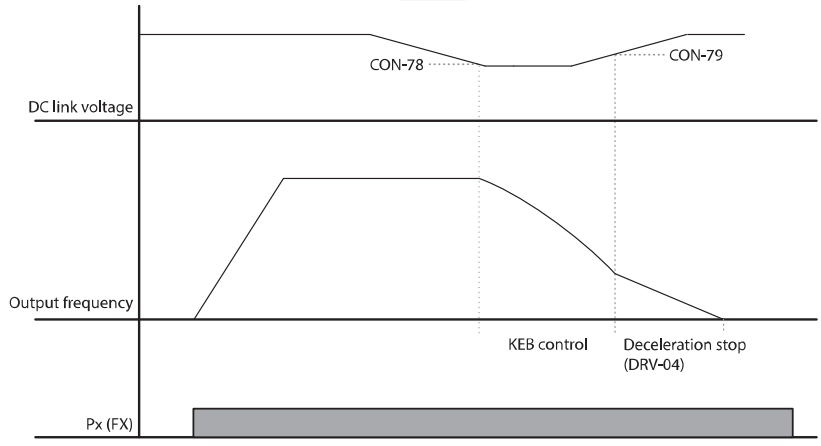
Kinetic Energy Buffering Operation

When the input power supply is disconnected, the drive's DC link voltage decreases, and a low voltage trip occurs blocking the output. A kinetic energy buffering operation uses regenerative energy generated by the motor during the blackout to maintain the DC link voltage. This extends the time for a low voltage trip to occur, after an instantaneous power interruption.

Pr. Group	Pr. Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
Cn	77	Kinetic energy buffering selection	KEB Select	0	None	0–2	–
				1	KEB–1		
				2	KEB–2		
	78	Kinetic energy buffering start level	KEB Start Lev	125.0		110.0–200.0	%
	79	Kinetic energy buffering stop level	KEB Stop Lev	130.0		Cn.78–210.0	%
	80	Energy buffering P gain	KEB P Gain	1000		0–20000	–
	81	Energy buffering I gain	KEB I Gain	500		1–20000	–
	82	Energy buffering Slip gain	KEB Slip Gain	30.0		0–2000.0%	–
	83	Energy buffering acceleration time	KEB Acc Time	10.0		0.0–600.0s	–
In	65 –69	Px terminal function setting	Px Define	52	KEB–1 Select	–	–

Kinetic Energy Buffering Operation Setting Details

<table>
<tr><th>Pr. Code</th><th colspan="3">Description</th></tr>
<tr><td rowspan="6">Cn.77 KEB Select</td><td colspan="3">Select the kinetic energy buffering operation when the input power is disconnected. If 1 or 2 is selected, it controls the drive's output frequency and charges the DC link (drive's DC part) with energy generated from the motor. Also, this function can be set using a terminal input. From the Px terminal function settings, select KEB–1 Select, and then turn on the terminal block to run the KEB–1 function. (If KEB–1 Select is selected, KEB–1 or KEB–2 cannot be set in Cn.77.)</td></tr>
<tr><td>Setting</td><td></td><td>Function</td></tr>
<tr><td>0</td><td>None</td><td>General deceleration is carried out until a low voltage trip occurs.</td></tr>
<tr><td>1</td><td>KEB–1</td><td>When the input power is blocked, it charges the DC link with regenerated energy. When the input power is restored, it restores normal operation from the energy buffering operation to the frequency reference operation. KEB Acc Time in Cn.89 is applied as the operation frequency acceleration time when restoring to the normal operation.</td></tr>
<tr><td>2</td><td>KEB–2</td><td>When the input power is blocked, it charges the DC link with regenerated energy. When the input power is restored, it changes from the energy buffering operation to the deceleration stop operation. The Dec Time in dr.4 is applied as the operation frequency deceleration time during the deceleration stop operation.</td></tr>
<tr><td colspan="3"> 

<u>KEB–1</u>
 

<u>KEB–2</u></td></tr>
<tr><td>Cn.78 KEB Start Lev, Cn.79 KEB Stop Lev</td><td colspan="3">Sets the start and stop points of the kinetic energy buffering operation. The set values must be based on the low voltage trip level as 100% and the stop level (Cn. 79) must be set higher than the start level (Cn.78).</td></tr>
<tr><td>Cn.80 KEB P Gain</td><td colspan="3">The controller P Gain is for maintaining the voltage of the DC power section during thekinetic energy buffering operation. Change the setting value when a low voltage trip occurs right after a power failure.</td></tr>
<tr><td>Cn.81 KEB I Gain</td><td colspan="3">The controller I Gain is for maintaining the voltage of the DC power section during the kinetic energy buffering operation. Sets the gain value to maintain the frequency during the kinetic energy buffering operation until the drive stops.</td></tr>
</table>

Pr. Code	Description
Cn.82 KEB Slip Gain	The slip gain is for preventing a low voltage trip due to load when the kinetic energy buffering operation start from blackout.
Cn.83 KEB Acc Time	Set the acceleration time of operation frequency when it restores normal operation from the kinetic energy buffering operation under the input power is restored.

CAUTION: Depending on the duration of Instantaneous power interruptions and the amount of load inertia, a low voltage trip may occur even during a kinetic energy buffering operation. Motors may vibrate during kinetic energy buffering operation for some loads except variable torque load (for example, fan or pump loads).

Torque Control

When the motor output torque is greater than the load, the speed of motor becomes too fast. To prevent this, set the speed limit. (The torque control function cannot be used while the speed limit function is running.)

The torque control function controls the motor to maintain the preset torque value. The motor rotation speed maintains the speed constantly when the output torque and load torque of the motor keep a balance. Therefore, the motor rotation speed is decided by the load when controlling the torque.

Torque control setting option

Pr. Group	Pr. Code	Name	LCD Display	Parameter Setting		Unit
dr	09	Control mode	Control Mode	4	IM Sensorless	–
	10	Torque control	Torque Control	1	Yes	–

Torque control setting option details

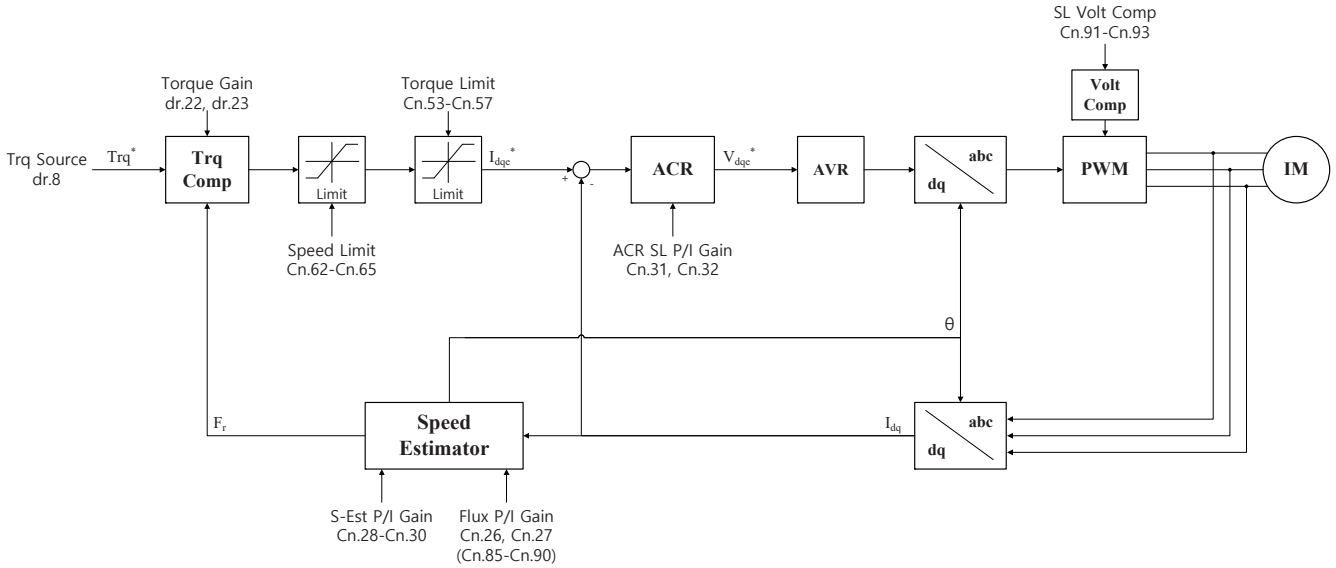
Pr. Group	Pr. Code	Name	Parameter Setting		Unit
dr	02	Cmd Torque	–	0.0	%
	08	Trq Ref Src	0	Keypad–1	–
	09	Control Mode	4	IM Sensorless	–
	10	Torque Control	1	Yes	–
	22	(+) Trq Gain	50–150		%
	23	(–) Trq Gain	50–150		%
	24	(–) Trq Gain0	50–150		%
	25	(–) Trq offset	0–100		%
bA	20	Auto Tuning	1	Yes	–
Cn	62	Speed LmtSrc	0	Keypad–1	–
	63	FWD Speed Lmt	–	60.00	Hz
	64	REV Speed Lmt	–	60.00	Hz
	65	Speed Lmt Gain	–	100	%
In	65–69	Px Define	35	Speed/Torque	–
OU	31–33	Relay1 or Q1	27	Torque Dect	–
OU	59	TD Level	–	100	%
OU	60	TD Band	–	5.0	%

NOTE:
To operate in torque control mode, basic operation conditions must be set. For more information, refer to "Sensorless Vector Control Operation Guide for Induction Motors" on page 4-153.
- *The torque control cannot be used in a low speed regeneration area or low load conditions.*
- *If you change the rotation direction while operating, an over current trip or low speed reverse direction error will be generated.*

Sensorless Vector Control Block Diagram

IM Sensorless Vector Control (IMSVC) – Torque Control

When dr.9 is set to 4: IM Sensorless & dr.10 is set to 1, the IM Sensorless Torque Control diagram is as shown here:



Torque reference setting option

The torque reference can be set using the same method as the target frequency setting. If Torque Control Mode is selected, the target frequency is not used.

Pr. Group	Pr. Code	Name	LCD Display	Parameter Setting		Unit
dr	02	Torque command	Cmd Torque	–180–180		%
	08	Torque reference setting	Trq Ref Src	0	Keypad–1	–
				1	Keypad–2	
				2	V1	
				4	V2	
				5	I2	
				6	Int 485	
				8	FieldBus (Ethernet)	
				9	UserSeqLink	
				12	Pulse	
Cn	62	Speed limit setting	Speed LmtSrc	0	Keypad–1	–
				1	Keypad–2	
				2	V1	
				4	V2	
				5	I2	
				6	Int 485	
				7	FieldBus (Ethernet)	
				8	UserSeqLink	
	63	Positive–direction speed limit	FWD Speed Lmt	0–Maximum frequency		Hz
	64	Negative–direction speed limit	REV Speed Lmt	0– Maximum frequency		Hz
	65	Speed limit operation gain	Speed Lmt Gain	100–5000		%
In	02	Torque at maximum analog input	Torque at 100%	–12.00–12.00		mA
CNF*	21	Monitor mode display 1	Monitor Line–1	1	Speed	–
	22	Monitor mode display 2	Monitor Line–2	2	Output Current	–
	23	Monitor mode display 3	Monitor Line–3	3	Output Voltage	–

**LCD keypad only*

Torque reference setting details

Pr. Code	Description		
dr.8	Select an input method to use as the torque reference.		
	Parameter Setting		Description
	0	Keypad–1	Sets the torque reference with the keypad.
	1	Keypad–2	
	2, 4, 5	V1, V2, I2	Sets the torque reference using the voltage or current input terminal of the terminal block.
	6	Int 485	Sets the torque reference with the communication terminal of the terminal block.
	8	FieldBus (Ethernet)	Input the torque reference using the drive's FieldBus (Ethernet) option.
	9	UserSeqLink	Enters torque reference by linking common area with the user sequence output.
	12	Pulse	Input the torque reference using the pulse input on the drive's terminal block.
Cn.2	The torque reference can be set up to 180% of the maximum rated motor torque.		
In.2	Sets the maximum torque. You can check the set maximum torque in Monitor (MON) mode.		
CNF.21–23	Select a parameter from the Config (CNF) mode and then select 19 (Torque Ref) (for monitoring)		

Speed limit details

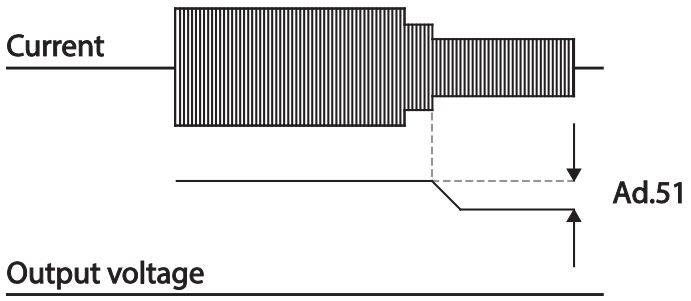
Pr. Code	Description		
Cn.62	Select a method for setting the speed limit value.		
	Parameter Setting		Description
	0	Keypad–1	Sets the speed limit value with the keypad.
	1	Keypad–2	
	2, 4, 5	V1, V2, I2	Sets the speed limit value using the same method as the frequency command. You can check the setting in Monitor (MON) mode.
	6	Int 485	
	7	FieldBus (Ethernet)	
	8	UserSeqLink	
Cn.63	Sets the positive–direction speed limit value.		
Cn.64	Sets the negative–direction speed limit value.		
Cn.65	Sets the decrease rate of the torque reference when the motor speed exceeds the speed limit value.		
CNF.21–23	Select a parameter from the Config (CNF) mode and then select 21 (Torque Bias) (for monitoring).		
In.65–69	Select a multi–functional input terminal to set as the (35 Speed/Torque). If you turn on the terminal while the operation is stopped, it operates in vector control (speed limit) mode.		

Energy Saving Operation

Manual Energy Saving Operation

If the drive output current is lower than the current which is set at bA.14 (Noload Curr), the output voltage must be reduced as low as the level set at Ad.51 (Energy Save). The voltage before the energy saving operation starts will become the base value of the percentage. Manual energy saving operation will not be carried out during acceleration and deceleration.

Pr. Group	Pr. Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
Ad	50	Energy saving operation	E–Save Mode	1	Manual	–	–
	51	Energy saving amount	Energy Save	30		0–30	%



Automatic Energy Saving Operation

The amount of energy saving can be automatically calculated based on the rated motor current (bA.13) and the no–load current (bA.14). From the calculations, the output voltage can be adjusted.

Pr. Group	Pr. Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
Ad	50	Energy saving operation	E–Save Mode	2	Auto	–	–

CAUTION: If operation frequency is changed or acceleration and /deceleration is carried out by a stop command during the energy saving operation, the actual Acc/Dec time may take longer than the set Acc/Dec time due to the time required to return to the gerneral operation from the energy saving operation.

Speed Search Operation

This operation is used to prevent fault trips that can occur while the drive output voltage is disconnected and the motor is idling. Because this feature estimates the motor rotation speed based on the drive output current, it does not give the exact speed.

Pr. Group	Pr. Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
Cn	69	PM speed search pulse current	SS Pulse Curr	15		10–100	%
	70	Speed search mode	SS Mode	0	Flying Start–1	0–2	–
				1	Flying Start–2		
				2	Flying Start–3		
	71	Speed search operation selection	Speed Search	0000*		0000–1111	bit
	72	Speed search reference current	SS Sup–Current	–	Below 75kW	80–200	%
	73	Speed search proportional gain	SS P–Gain	100		0–9999	–
	74	Speed search integral gain	SS I–Gain	200		0–9999	–
	75	Output block time before speed search	SS Block Time	1.0		0–60	sec
OU	31	Multi–function relay 1 item	Relay 1	19	Speed Search	0–40	–
	33	Multi–function output 1 item	Q1 Define				

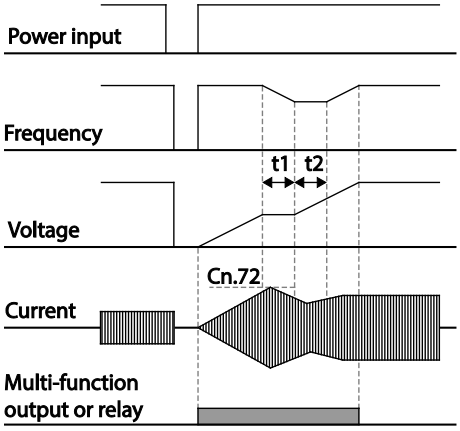
**See "Bit Selection" on page 4–3 for details*

Speed Search Operation Setting Details

<table>
<tr><th>Pr. Code</th><th colspan="3">Description</th></tr>
<tr><td>Cn.69 SS Pulse Curr</td><td colspan="3">Sets the speed search current based on the motor's rated current. This parameter is only displayed when dr.9 (Control Mode) is set to 6 (PM Sensorless).</td></tr>
<tr><td rowspan="5">Cn.70 SS Mode</td><td colspan="3">Select a speed search type.</td></tr>
<tr><td colspan="2">Setting</td><td>Function</td></tr>
<tr><td>0</td><td>Flying Start–1</td><td>The speed search is carried out as it controls the drive output current during idling below the Cn.72 (SS Sup–Current) parameter setting. If the direction of the idling motor and the direction of operation command at restart are the same, a stable speed search function can be performed at about 10Hz or lower. However, if the direction of the idling motor and the direction of operation command at restart are different, the speed search does not produce a satisfactory result because the direction of idling cannot be established.

*Only available for dr.9 = 0 or2 (V/F or Slip comp mode)</td></tr>
<tr><td>1</td><td>Flying Start–2</td><td>The speed search is carried out as it PI controls the ripple current which is generated by the counter electromotive force during no–load rotation. Because this mode establishes the direction of the idling motor (forward/reverse), the speed search function is stable regardless of the direction of the idling motor and direction of operation command. However because the ripple current is used which is generated by the counter electromotive force at idle (the counter electromotive force is proportional to the idle speed), the idle frequency is not determined accurately and re–acceleration may start from zero speed when the speed search is performed for the idling motor at low speed (about 10 – 15 Hz, though it depends on motor characteristics).

*Only available for dr.9 = 0,2,4 (V/F, Slip comp, or IM Sensorless mode)</td></tr>
<tr><td>2</td><td>Flying Start–3</td><td>This speed search is available when operating a PM synchronous motor. It is used when dr.9 (Control Mode) is set to 6 (PM Sensorless).</td></tr>
</table>

<table>
<tr><th>Pr. Code</th><th>Description</th></tr>
<tr><td rowspan="8">Cn.71 Speed Search</td><td colspan="5">Speed search can be selected from the following 4 options. If the top display segment is on it is enabled (On), and if the bottom segment is on it is disabled (Off). *See "Bit Selection" on page 4–3 for details</td></tr>
<tr><td colspan="5">Type and Functions of Speed Search Setting</td></tr>
<tr><td colspan="4">Setting</td><td rowspan="2">Function</td></tr>
<tr><td>bit4</td><td>bit3</td><td>bit2</td><td>bit1</td></tr>
<tr><td></td><td></td><td></td><td>X</td><td>Speed search for general acceleration</td></tr>
<tr><td></td><td></td><td>X</td><td></td><td>Initialization after a fault trip</td></tr>
<tr><td></td><td>X</td><td></td><td></td><td>Restart after instantaneous power interruption</td></tr>
<tr><td>X</td><td></td><td></td><td></td><td>Starting with power–on</td></tr>
<tr><td colspan="5">• Speed search for general acceleration: If bit 1 is set to 1 and the drive operation command runs, acceleration starts with speed search operation. When the motor is rotating under load, a fault trip may occur if the operation command is run for the drive to provide output voltage. The speed search function prevents such fault trip from occurring.
• Initialization after a fault trip: If Bit 2 is set to 1 and Pr.8 (RST Restart) is set to 1 (Yes), the speed search operation automatically accelerates the motor to the operation frequency used before the fault trip, when the [Reset] key is pressed (or the terminal block is initialized) after a fault trip.
• Automatic restart after reset of a fault trip: If bit 3 is set to 1, and if a low voltage trip occurs due to a power interruption but the power is restored before the internal power shuts down, the speed search operation accelerates the motor back to its frequency reference before the low voltage trip.
If an instantaneous power interruption occurs and the input power is disconnected, the drive generates a low voltage trip and blocks the output. When the input power returns, the operation frequency before the low voltage trip and the voltage is increased by the drive's inner PI control.
If the current increases above the value set at Cn.72, the voltage stops increasing and the frequency decreases (t1 zone). If the current decreases below the value set at Cn.27, the voltage increases again and the frequency stops decelerating (t2 zone). When the normal frequency and voltage are resumed, the speed search operation accelerates the motor back to its frequency reference before the fault trip.
 

• Starting with power–on: Set bit 4 to 1 and Ad.10 (Power–on Run) to 1 (Yes). If drive input power is supplied while the drive operation command is on, the speed search operation will accelerate the motor up to the frequency reference.</td></tr>
<tr><td>Cn.72 SS Sup–Current</td><td colspan="5">The amount of current flow is controlled during speed search operation based on the motor's rated current. If Cn.70 (SS mode) is set to 1 (Flying Start–2), this code is not visible.</td></tr>
<tr><td>Cn.73 SS P/I–Gain,
Cn.75 SS Block Time</td><td colspan="5">The P/I gain of the speed search controller can be adjusted. If Cn.70 (SS Mode) is set to 1 (Flying Start–2), different factory defaults based on motor capacity are used and defined in dr.14 (Motor Capacity).</td></tr>
</table>

NOTE:

- *If operated within the rated output, the ACN series drive is designed to withstand instantaneous power interruptions within 15 ms and maintain normal operation. Based on the rated heavy load current, safe operation during an instantaneous power interruption is guaranteed for 230V and 460V drives (whose rated input voltages of 200-230 VAC for 230V drives and 380-460 VAC for 460V drives.*
- *The DC voltage inside the drive may vary depending on the output load. If the power interruption time is longer than 15 ms, a low voltage trip may occur.*

CAUTION: When operating in sensorless mode while the starting load is in free–run, the speed search function (for general acceleration) must be set for smooth operation. If the speed search function is not set, an overcurrent trip or overload trip may occur.

Auto Restart Settings

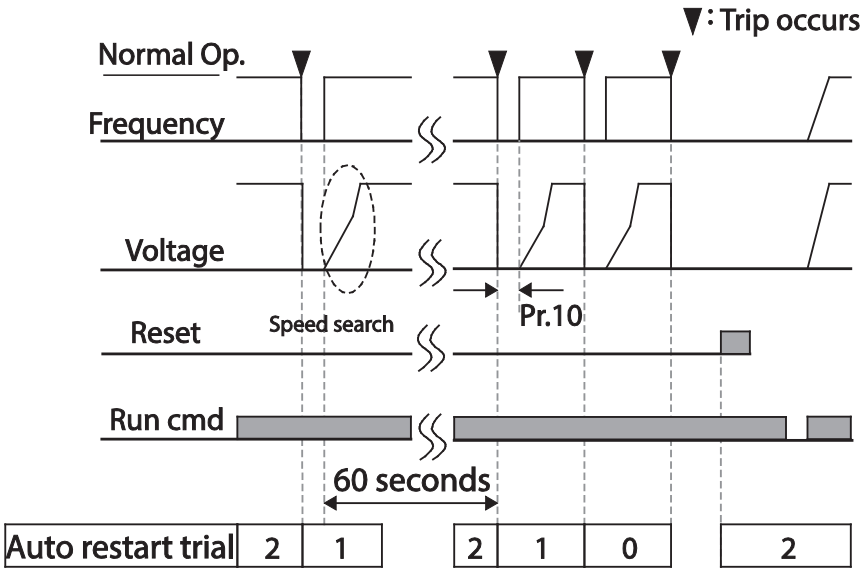
When drive operation stops due to a fault and a fault trip is activated, the drive automatically restarts based on the parameter settings.

Pr. Group	Pr. Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
Pr	08	Select start at trip reset	RST Restart	0	No	0–1	–
	09	Auto restart count	Retry Number	0		0–10	–
	10	Auto restart delay time	Retry Delay	1.0		0.0–60.0	s
Cn	71	Select speed search operation	Speed Search	–		0000*–1111	bit
	72	Speed search startup current	SS Sup–Current	150		80–200	%
	73	Speed search proportional gain	SS P–Gain	100		0–9999	–
	74	Speed search integral gain	SS I–Gain	200		0–9999	–
	75	Output block time before speed search.	SS Block Time	1.0		0.0–60.0	s

See "Bit Selection" on page 4–3 for details

Auto Restart Setting Details

Pr. Code	Description
Pr.8 RST Restart, Pr.9 Retry Number, Pr.10 Retry Delay	Only operates when Pr.8 (RST Restart) is set to 1(Yes). The number of attempts to try the auto restart is set at Pr.9 (Auto Restart Count). If a fault trip occurs during operation, the drive automatically restarts after the set time programmed at Pr.10 (Retry Delay). At each restart, the drive counts the number of tries and subtracts it from the number set at Pr.9 until the retry number count reaches 0. After an auto restart, if a fault trip does not occur within 60 sec, it will increase the restart count number. The maximum count number is limited by the number set at Pr.9 (Auto Restart Count). If the drive stops due to low voltage, emergency stop (Bx), drive overheating, or hardware diagnosis, an auto restart is not activated. At auto restart, the acceleration options are identical to those of speed search operation. Codes Cn.72–75 can be set based on the load. Information about the speed search function can be found at "Speed Search Operation" on page 4–169.



Example of auto restart with a setting of 2

CAUTION: If the auto restart number is set, be careful when the drive resets from a fault trip. The motor may automatically Rotate on Power Up.

Operational Noise Settings (carrier frequency settings)

Pr. Group	Pr. Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
Cn	04	Carrier Frequency	Carrier Freq	3.0		1.0–15.0	kHz
	05	Switching Mode	PWM* Mode	0	Normal PWM	0–1	–
**PWM: Pulse width modulation*							

Operational Noise Setting Details

<table>
<tr><th>Pr. Code</th><th colspan="3">Description</th></tr>
<tr><td>Cn.4 Carrier Freq</td><td colspan="3">Adjust motor operational noise by changing carrier frequency settings. Power transistors (IGBT) in the drive generate and supply high frequency switching voltage to the motor. The switching speed in this process refers to the carrier frequency. If the carrier frequency is set high, it reduces operational noise from the motor, and if the carrier frequency is set low, it increases operational noise from the motor.</td></tr>
<tr><td rowspan="7">Cn.5 PWM Mode</td><td colspan="3">The heat loss and leakage current from the drive can be reduced by changing the load rate option at Cn.5 (PWM Mode). Selecting 1 (LowLeakage PWM) reduces heat loss and leakage current, compared to when 0 (Normal PWM) is selected. However, it increases the motor noise. Low leakage PWM uses 2 phase PWM modulation mode, which helps minimize degradation and reduces switching loss by approximately 30%.</td></tr>
<tr><td rowspan="3">Item</td><td colspan="2">Carrier frequency</td></tr>
<tr><td>1.0kHz</td><td>15kHz</td></tr>
<tr><td>Low Leakage PWM</td><td>Normal PWM</td></tr>
<tr><td>Motor noise</td><td>▲</td><td>▼</td></tr>
<tr><td>Heat generation</td><td>▼</td><td>▲</td></tr>
<tr><td>Noise generation</td><td>▼</td><td>▲</td></tr>
<tr><td>Leakage current</td><td>▼</td><td>▲</td></tr>
</table>

2nd Motor Operation

The 2nd motor operation is used when a single drive switch operates two motors. Using the 2nd motor operation, a parameter for the 2nd motor is set. The 2nd motor is operated when a multi–function terminal input defined as a 2nd motor function is turned on.

Pr. Group	Pr. Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
In	65– 69	Px terminal configuration	Px Define(Px: P1–P5)	26	2nd Motor	0–54	–

2nd Motor Operation Setting Details

Pr. Code	Description
In.65–69 Px Define	Set one of the the multi–function input terminals (P1–P5) to 26 (2nd Motor) to display M2 (2nd motor group) group. An input signal to a multi–function terminal set to 2nd motor will operate the motor according to the code settings listed below. However, if the drive is in operation, input signals to the multi–function terminals will not read as a 2nd motor parameter. Pr.50 (Stall Prevent) must be set first, before M2.28 (M2–Stall Lev) settings can be used. Also, Pr.40 (Electronic Thermal [ETH] Trip Sel) must be set first, before M2.29 (M2–ETH 1min) and M2.30 (M2.ETH Cont) settings.

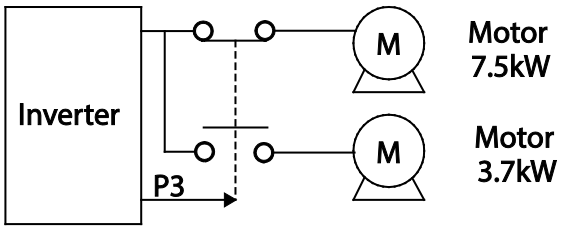
Parameter Setting at Multi–function Terminal Input on a 2nd Motor

Pr. Code	Description	Pr. Code	Description
M2.4 Acc Time	Acceleration time	***M2.16 Inertia Rt***	Load inertia rate
M2.5 Dec Time	Deceleration time	***M2.17 Rs***	Stator resistance
M2.6 Capacity	Motor capacity	***M2.18 Lsigma***	Leakage inductance
M2.7 Base Freq	Motor base frequency	***M2.19 Ls***	Stator inductance
M2.8 Ctrl Mode	Control mode*	***M2.20 Tr***	Rotor time constant
M2.10 Pole Num	Pole number	***M2.25 V/F Patt***	V/F pattern
M2.11 Rate Slip	Rated slip	***M2.26 Fwd Boost***	Forward torque boost
M2.12 Rated Curr	Rated current	***M2.27 Rev Boost***	Reverse torque boost
M2.13 Noload Curr	No–load current	***M2.28 Stall Lev***	Stall prevention level
M2.14 Rated Volt	Motor rated voltage	***M2.29 ETH 1min***	Motor Elec. Thermal protection 1min rating
M2.15 Efficiency	Motor efficiency	***M2.30 ETH Cont***	Motor Elec. Thermal protection continuous rating
**Control mode dr.9=6 is not supported.*			

Example – 2nd Motor Operation

Use the 2nd motor operation when switching operation between a 7.5 kW motor and a secondary 3.7 kW motor connected to terminal P3. Refer to the following settings.

Pr. Group	Pr. Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
In	67	Terminal P3 configuration	P3 Define	26	2nd Motor	–	–
M2	06	Motor capacity	M2–Capacity	–	3.7kW	–	–
	08	Control mode	M2–Ctrl Mode	0	V/F	–	–

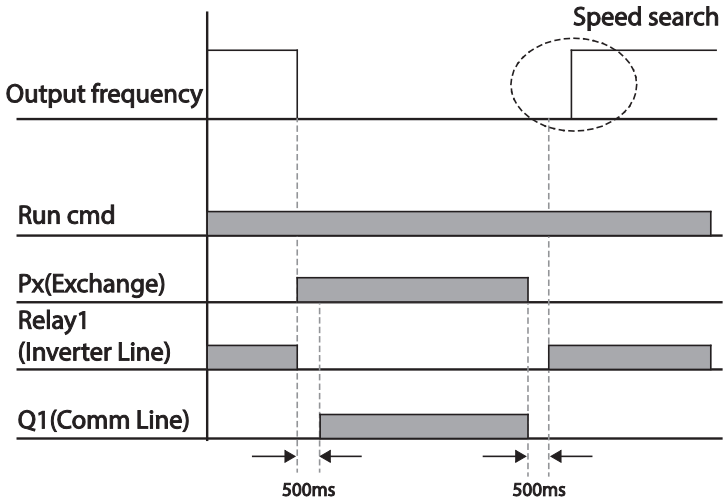


Supply Power Transition

Supply power transition is used to switch the power source for the motor connected to the drive from the drive output power to the main supply power source (commercial power source), or vice versa.

Pr. Group	Pr. Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
In	65–69	Px terminal configuration	Px Define(Px: P1–P5)	16	Exchange	0–54	–
OU	31	Multi–function relay1 items	Relay1	17	Drive Line	–	–
	33	Multi–function output1 items	Q1 Define	18	Comm Line	–	–

Supply Power Transition Setting Details

Pr. Code	Description
In.65–69 Px Define	When the motor power source changes from drive output to main supply power, select a terminal to use and set the code value to 16 (Exchange). Power will be switched when the selected terminal is on. To reverse the transition, switch off the terminal.
OU.31 Relay 1 Define (A1, B1, C1 terminals), OU.33 Q1 Define	Set multi–function relay or multi–function output to 17 (Drive Line) or 18 (COMM line). Relay operation sequence is as follows. 

Cooling Fan Control

This function turns the drive's heat–sink cooling fan on and off. It is used in situations where the load stops and starts frequently, or noise free environment is required. The correct use of cooling fan control can extend the cooling fan's life.

Pr. Group	Pr. Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
Ad	64	Cooling fan control	FAN Control	0	During Run	0–2	–

Cooling Fan Control Detail Settings

Pr. Code	Description		
Ad.64 Fan Control	Settings		Description
	0	During Run	Cooling fan runs when the power is supplied to the drive and the operation command is on. The cooling fan stops when the power is supplied to the drive and the operation command is off. When the drive heat sink temperature is higher than its set value, the cooling fan operates automatically regardless of its operation status.
	1	Always On	Cooling fan runs constantly if the power is supplied to the drive.
	2	Temp Control	With power connected and the run operation command on, if the setting is in Temp Control, the cooling fan will not operate unless the temperature in the heat sink reaches the set temperature.

NOTE: Despite setting Ad.64 to 0(During Run), if the heat sink temperature reaches a set level by current input harmonic wave or noise, the cooling fan may run as a protection function.

Input Power Frequency and Voltage Settings

Select the frequency for drive input power. If the frequency changes from 60Hz to 50Hz, all other frequency (or RPM) settings including the maximum frequency, base frequency etc., will change to 50Hz. Likewise, changing the input power frequency setting from 50Hz to 60Hz will change all related function item settings from 50Hz to 60Hz.

Pr. Group	Pr. Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
bA	10	Input power frequency	60/50 Hz Sel	0	60Hz	0–1	–
				1	50Hz		

Set Drive input power voltage at bA.19. Low voltage fault trip level changes automatically to the set voltage standard.

Pr. Group	Pr. Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
bA	19	Input power voltage	AC Input Volt	230V	220	170–240	V
				460V	380	320–480	

Read, Write, and Save Parameters

For use with the optional ACN-LCD advanced keypad only, Use read, write and save function parameters on the drive to copy parameters from the drive to the LCD keypad or from the LCD keypad to the drive.

Pr. Group	Pr. Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
CNF*	46	Parameter read	Parameter Read	1	Yes	–	–
	47	Parameter write	Parameter Write	1	Yes	–	–
	48	Parameter save	Parameter Save	1	Yes	–	–

**Available on ACN-LCD keypad only.*

Read, Write, and Save Parameter Setting Details

Pr. Code	Description
CNF.46 Parameter Read	Copies saved parameters from the drive to the keypad. Saved parameters on the keypad will be deleted and replaced with copied parameters.
CNF.47 Parameter Write	Copies saved parameters from the keypad to the drive. Saved parameters on the drive will be deleted and replaced with copied parameters. If an error occurs during parameter writing, previous saved data will be used. If there is no saved data on the Keypad, 'EEP Rom Empty' message will be displayed.
CNF.48 Parameter Save	As parameters set during communication transmission are saved to RAM, the setting values will be lost if the power goes off and on. When setting parameters during communication transmission, select 1 (Yes) from CNF.48 code to save the set parameter.

Parameter Initialization (Reset to Defaults)

User changes to parameters can be initialized (reset) to factory default settings on all or selected groups. However, during a fault trip situation or operation, parameters cannot be initialized.

Pr. Group	Pr. Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
dr*	93	Parameter initialization	–	0	No	0–16	–
CNF*	40	Parameter initialization	Parameter Init	0	No	0–16	–

**For standard drive keypad*
***For ACN-LCD keypad*

Parameter Initialization Setting Details

Pr. Code	Description			
dr.93, CNF.40 Parameter Init	Setting		LCD Display	Function
	0	No	No	–
	1	Initialize all groups	All Grp	Initialize all data. Select 1(All Grp) and press [PROG/ENT] key to start initialization. On completion, 0(No) will be displayed.
	2	Initialize dr group	DRV Grp	Initialize data by groups. Select initialize group and press [PROG/ENT] key to start initialization. On completion, 0(No) will be displayed.
	3	Initialize bA group	BAS Grp	
	4	Initialize Ad group	ADV Grp	
	5	Initialize Cn group	CON Grp	
	6	Initialize In group	IN Grp	
	7	Initialize OU group	OUT Grp	
	8	Initialize CM group	COM Grp	
	9	Initialize AP group	APP Grp	
	11	Initialize APO group	APO Grp	
	12	Initialize Pr group	PRT Grp	
	13	Initialize M2 group	M2 Grp	
	14	Initialize USS group	USS Grp	
	15	Initialize USF group	USF Grp	
	16	Initialize OperationGroup	SPS Grp	

Parameter View Lock

For use with ACN-LCD keypad only, Use parameter view lock to hide parameters after registering and entering a user password.

Pr. Group	Pr. Code	Name	LCD Display	Parameter Setting	Setting Range	Unit
CNF*	50	Parameter view lock	View Lock Set	Unlocked	0–9999	–
	51	Parameter view lock password	View Lock Pw	Password	0–9999	–
**Available on ACN-LCD keypad only.*						

Parameter View Lock Setting Details

Pr. Code	Description	
CNF.51 View Lock Pw	Register a password to allow access to parameter view lock. Follow the steps below to register a password.	
	No	Procedure
	1	[PROG/ENT] key on CNF.51 code will show the previous password input window. If registration is made for the first time, enter 0. It is the factory default.
	2	If a password had been set, enter the saved password.
	3	If the entered password matches the saved password, a new window prompting the user to enter a new password will be displayed (the process will not progress to the next stage until the user enters a valid password).
	4	Register a new password.
	5	After registration, code CNF.53 will be displayed.
CNF.50 View Lock Set	To enable parameter view lock, enter a registered password. [Locked] sign will be displayed on the screen to indicate that parameter view lock is enabled. To disable parameter view lock, re–enter the password. The [locked] sign will disappear.	

Parameter Lock

Use parameter lock to prevent unauthorized modification of parameter settings. To enable parameter lock, register and enter a user password first.

Pr. Group	Pr. Code	Name	LCD Display	Parameter Setting	Setting Range	Unit
dr	94	Password registration	–	–	0–9999	–
	95	Parameter lock password	–	–	0–9999	–
CNF*	52	Parameter lock	Key Lock Set	Unlocked	0–9999	–
	53	Parameter lock password	Key Lock PW	Password	0–9999	–

**Available on ACN-LCD keypad only.*

Pr. Code	Description	
dr.94 Password Registration	Setting the Password. Follow the procedures below to register a password.	
	No	Procedures
	1	Press the [PROG/ENT] key twice on dr.94 code.
	2	Set the desired password with the arrow keys.
	3	Press the [PROG/ENT] key twice. The display will return to dr.94.
	Changing the Password	
	No	Procedures
	1	Press the [PROG/ENT] key on dr.94 code. 0000 will be displayed.
	2	Use the arrow keys to enter the current password.
	3	Press the [PROG/ENT] key. The value should remain on the display.
	4	Set the new password with the arrow keys.
	5	Press the [PROG/ENT] key twice. The display will return to dr.94.
dr.95 Parameter Lock Password	Locking the Drive.	
	No	Procedure
	1	Press the [PROG/ENT] key on dr.95 code. UL will be displayed. This means the drive is currently unlocked.
	2	Press the [PROG/ENT] key again to display 0000.
	3	Enter the password using the arrow keys.
	4	Press the [PROG/ENT] key. L will be displayed. This means the drive is locked. (If no password has been registered, drive remains unlocked and displays UL.)
	Unlocking the Drive.	
	No	Procedure
	1	Press the [PROG/ENT] key on dr.95 code. L will be displayed. This means the drive is currently locked.
	2	Press the [PROG/ENT] key again to display 0000.
	3	Enter the password using the arrow keys.
	4	Press the [PROG/ENT] key. UL will be displayed. This means the drive is unlocked.

Parameter Lock Setting Details

Pr. Code	Description	
CNF.53 Key Lock Pw	Register a password to prohibit parameter modifications. Follow the procedures below to register a password.	
	No	Procedures
	1	Press the [PROG/ENT] key on CNF.53 code and the saved password input window will be displayed. If password registration is being made for the first time, enter 0. It is the factory default.
	2	If a saved password has been set, enter the saved password.
	3	If the entered password matches the saved password, then a new window to enter a new password will be displayed. (The process will not move to next stage until the user enters a valid password).
	4	Register a new password.
	5	After registration, Code CNF.51 will be displayed.
CNF.52 Key Lock Set	To enable parameter lock, enter the registered password. [Locked] sign will be displayed on the screen to indicate that prohibition is enabled. Once enabled, Pressing the [PROG/ENT] key on function code will not allow the display edit mode to run. To disable parameter modification prohibition, re–enter the password. The [Locked] sign will disapear.	

CAUTION: If parameter view lock and parameter lock functions are enabled, no drive operation related function changes can be made. It is very important that you memorize the password.

Changed Parameter Display

This feature displays all the parameters that are different from the factory defaults. Use this feature to track changed parameters.

Pr. Group	Pr. Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
CNF*	41	Changed parameter display	Changed Para	0	View All	–	–
**Available on ACN-LCD keypad only.*							

Changed Parameter Display Setting Details

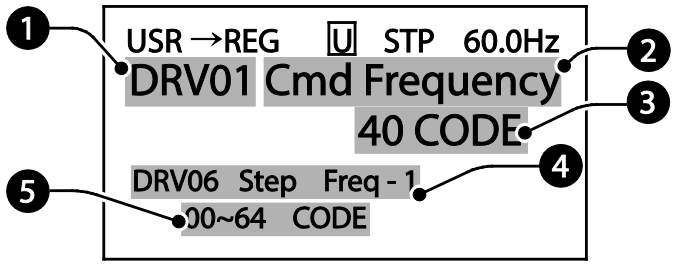
Pr. Code	Description		
CNF.41 Changed Para	Setting		Function
	0	View All	Display all parameters
	1	View Changed	Display changed parameters only

User Group

Create a user defined group and register user–selected parameters from the existing function groups. The user group can carry up to a maximum of 64 parameter registrations.

Pr. Group	Pr. Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
CNF*	42	Multi–function key settings	Multi Key Sel	3	UserGrp SelKey	–	–
	45	Delete all user registered codes	UserGrp AllDel	0	No	–	–
**Available on ACN-LCD keypad only.*							

User Group Setting Details

<table>
<tr><th>Pr. Code</th><th colspan="2">Description</th></tr>
<tr><td rowspan="15">CNF.42 Multi–Key Sel</td><td colspan="2">Select 3(UserGrp SelKey) from the multi–function key setting options. If user group parameters are not registered, setting the multi–function key to the user group select key (UserGrp SelKey) will not display user group (USR Grp) item on the Keypad.</td></tr>
<tr><td colspan="2">Follow the procedures below to register parameters to a user group.</td></tr>
<tr><td>No</td><td>Procedure</td></tr>
<tr><td>1</td><td>Set CNF. 42 to 3(UserGrp SelKey). A “U” icon will be displayed at the top of the LCD display.</td></tr>
<tr><td>2</td><td>In the parameter mode (PAR Mode), move to the parameter you need to register and press the [MULTI] key. For example, if the [MULTI] key is pressed in the frequency reference in DRV 01 (Cmd Frequency), the screen below will be displayed.
 

1) Group name and code number of the parameter
2) Name of the parameter
3) Code number to be used in the user group. Pressing the [PROG/ENT] key on the code number (40 Code) will register DRV–01 as code 40 in the user group.
4) Existing parameter registered as the user group code 40
5) Setting range of the user group code. Entering 0 cancels the settings.</td></tr>
<tr><td>3</td><td>Set a code number (3) to use to register the parameter in the user group. Select code number and press [PROG/ENT] key.</td></tr>
<tr><td>4</td><td>Changing the value in (3) will also change the value in (4). If no code is registered, ‘Empty Code’ will be displayed. Entering 0 cancels the settings.</td></tr>
<tr><td>5</td><td>The registered parameters are listed in the user group in U&M mode. You can register one parameter multiple times if necessary. For example, a parameter can be registered as code 2, code 11, and more in the user group.</td></tr>
<tr><td colspan="2">Follow the procedures below to delete parameters in the user group.</td></tr>
<tr><td>No.</td><td>Settings</td></tr>
<tr><td>1</td><td>Set CNF. 42 to 3(UserGrp SelKey). A ‘U’ icon will be displayed at the top of the LCD display.</td></tr>
<tr><td>2</td><td>In the USR group in U&M mode, move the cursor to the code that is to be deleted.</td></tr>
<tr><td>3</td><td>Press the [MULTI] key.</td></tr>
<tr><td>4</td><td>Move to YES on the deletion confirmation screen, and press the [PROG/ENT] key.</td></tr>
<tr><td>5</td><td>Deletion completed.</td></tr>
<tr><td>CNF.25 UserGrp AllDel</td><td colspan="2">Set to 1(Yes) to delete all registered parameters in the user group.</td></tr>
</table>

Easy Start On

For use with the ACN-LCD advanced keypad only, run Easy Start On to easily setup the basic motor parameters required to operate a motor in a batch. Set CNF.61(Easy Start On) to 1(Yes) to activate the feature, initialize all parameters by setting CNF.40 (Parameter Init) to 1 (All Grp), and restart the drive to activate Easy Start On.

Pr. Group	Pr. Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
CNF*	61	Parameter easy start settings	Easy Start On	1	Yes	–	–
**Available on ACN-LCD keypad only.*							

Easy Start On Setting Details

Pr. Code	Description	
CNF.61 Easy Start On	Follow the procedures listed below to set parameter easy start.	
	No	Procedures
	1	Set CNF.61 (Easy Start On) to 1(Yes).
	2	Select 1(All Grp) in CNF.40 (Parameter Init) to initialize all parameters in the drive.
	3	Restarting the drive will activate the Easy Start On. Set the values in the following screens on the LCD keypad. To escape from the Easy Start On, press the [ESC] key. • Start Easy Set: Select Yes. • DRV.14 Motor Capacity: Set motor capacity. • BAS.11 Pole Number: Set motor pole number. • BAS.15 Rated Volt: Set motor rated voltage. • BAS.10 60/50Hz Sel: Set motor rated frequency. • BAS.19 AC Input Volt: Set input voltage. • DRV.06 Cmd Source: Set command source. • DRV.01 Cmd Frequency: Set operation frequency. When the settings are completed, the minimum parameter setting on the motor has been made. The LCD keypay will return to a monitoring display. Now the motor can be operated with the command source set at DRV–06.

Config(CNF) Mode

The config mode parameters are used to configure the LCD keypad related features.

Pr. Group	Pr. Code	Name	LCD Display	Parameter Setting	Setting Range	Unit
CNF*	2	LCD brightness/contrast adjustment	LCD Contrast	–	–	–
	10	Drive S/W version	Inv S/W Ver	x.xx	–	–
	11	Keypad S/W version	Keypad S/W Ver	x.xx	–	–
	12	Keypad title version	KPD Title Ver	x.xx	–	–
	30–32	Open slot type	Option–x Type	None	–	–
	44	Erase trip history	Erase All Trip	No	–	–
	60	Add title update	Add Title Up	No	–	–
	62	Initialize accumulated electric energy	WH Count Reset	No	–	–

**Available on the LCD keypad only.*

Config Mode Parameter Setting Details

Pr. Code	Description
CNF.2 LCD contrast	Adjusts LCD brightness/contrast on the LCD keypad.
CNF.10 Inv S/W Ver, CNF.11 Keypad S/W Ver	Check OS version in the drive and on the LCD keypad.
CNF.12 KPD title Ver	Checks title version on the LCD keypad.
CNF.30–32 Option–x type	Checks type of powerboard installed in 1–3 power slot
CNF.44 Erase all trip	Deletes stored trip history.
CNF.60 Add Title Up	When drive SW version is updated and more code is added, CNF.60 settings will add, display, and operate the added codes. Set CNF.60 to 1(Yes) and disconnect the LCD keypad from the drive. Reconnecting the LCD keypad to the drive updates titles.
CNF.62 WH Count Reset	Initialize accumulated electric energy consumption count.

Multi-function IO Timer Settings

Set a multi–function input terminal to a timer and On/Off control the multi–function output and relay according to the timer settings.

Pr. Group	Pr. Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
In	65–69	Px terminal configuration	Px Define(Px: P1–P5)	38	Timer In	0–54	–
OU	31	Multi–function relay1	Relay 1	28	Timer Out	–	–
	33	Multi–function output1	Q1 Define				
	55	Timer on delay	Timer on delay	3.00		0.00–100	sec
	56	Timer off delay	Timer off delay	1.00		0.00–100	sec

Timer Setting Details

Pr. Code	Description
In.65–69 Px Define	Choose one of the multi–function input terminals and change it to a timer terminal by setting it to 38 (Timer In).
OU.31 Relay1, ***OU.33 Q1 Define***	Set multi–function output terminal or relay to be used as a timer to 28 (Timer out).
OU.55 TimerOn Delay, ***OU.56 TimerOff Delay***	Input a signal (On) to the timer terminal to operate a timer output (Timer out) after the time set at OU.55 has passed. When the multi–function input terminal is off, multi–function output or relay turns off after the time set at OU.56.

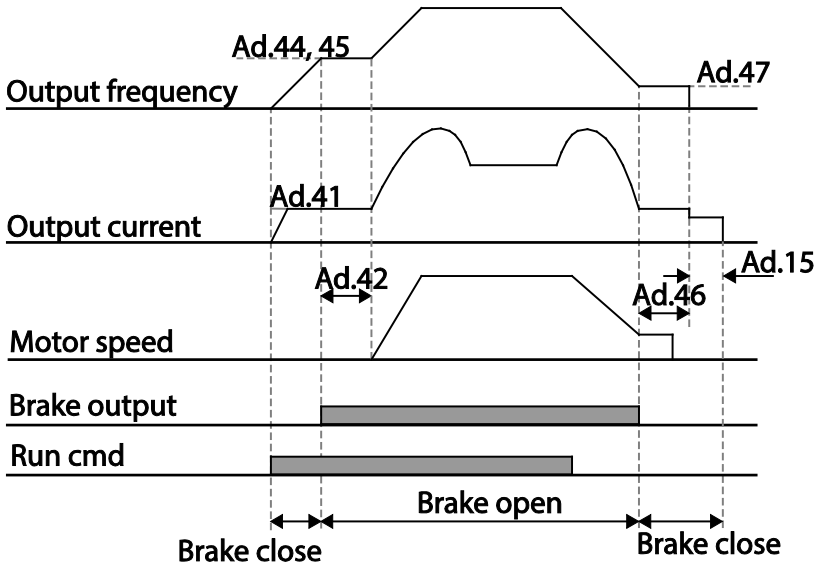
Brake Control

Brake control is used to control the On/Off operation of electronic brake load system.

Pr. Group	Pr. Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
dr	09	Control mode	Control Mode	0	V/F	–	–
Ad	41	Brake open current	BR Rls Curr	50.0		0.0–180%	%
	42	Brake open delay time	BR Rls Dly	1.00		0.0–10.0	sec
	44	Brake open forward frequency	BR Rls Fwd Fr	1.00		0–Maximum frequency	Hz
	45	Brake open reverse frequency	BR Rls Rev Fr	1.00		0–Maximum frequency	Hz
	46	Brake close delay time	BR Eng Dly	1.00		0.00–10.00	sec
	47	Brake close frequency	BR Eng Fr	2.00		0–Maximum frequency	Hz
OU	31	Multi–function relay1 item	Relay 1	35	BR Control	–	–
	33	Multi–function output1 item	Q1 Define				

When brake control is activated, DC braking (Ad.12) at drive start and dwell operation (Ad.20–23) do not operate.

- *Brake release sequence: During motor stop state, if an operation command is entered, the drive accelerates up to brake release frequency (Ad.44– 45) in forward or in reverse direction. After reaching brake release frequency, if motor current reaches brake release current (BR Rls Curr), the output relay or multi function output terminal for brake control sends a release signal. Once the signal has been sent, acceleration will begin after maintaining frequency for brake release delay time (BR Rls Dly).*
- *Brake engage sequence: If a stop command is sent during operation, the motor decelerates. Once the output frequency reaches brake engage frequency (BR Eng Fr), the motor stops deceleration and sends out a brake engage signal to a preset output terminal. Frequency is maintained for the brake engage delay time (BR Eng Dly) and will become 0 afterwards. If DC braking time (Ad.15) and DC braking resistance (Ad.16) are set, drive output is blocked after DC braking. For DC braking, refer to "Stop After DC Braking" on page 4–100.*



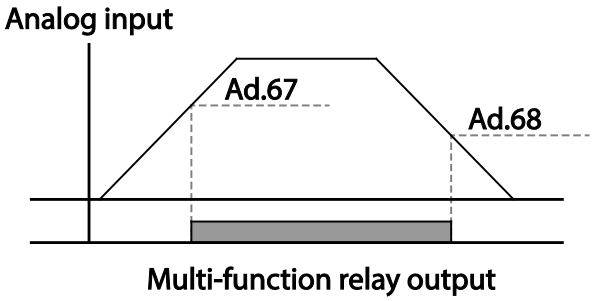
Multi–Function Output On/Off Control

Set reference values (on/off level) for analog input and control output relay or multi–function output terminal on/off status accordingly.

Pr. Group	Pr. Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
Ad	66	Output terminal on/off control mode	On/Off Ctrl Src	1	V1	–	–
	67	Output terminal on level	On–C Level	90.00		Output terminal off level– 100.00%	%
	68	Output terminal off level	Off–C Level	10.00		0.00–Output terminal on level	%
OU	31	Multi–function relay1 item	Relay 1	34	On/Off	–	–
	33	Multi–function output1 item	Q1 Define				

Multi–function Output On/Off Control Setting Details

Pr. Code	Description
Ad.66 On/Off Ctrl Src	Select analog input On/Off control.
Ad.67 On–C Level , Ad.68 Off–C Level	Set On/Off level at the output terminal.



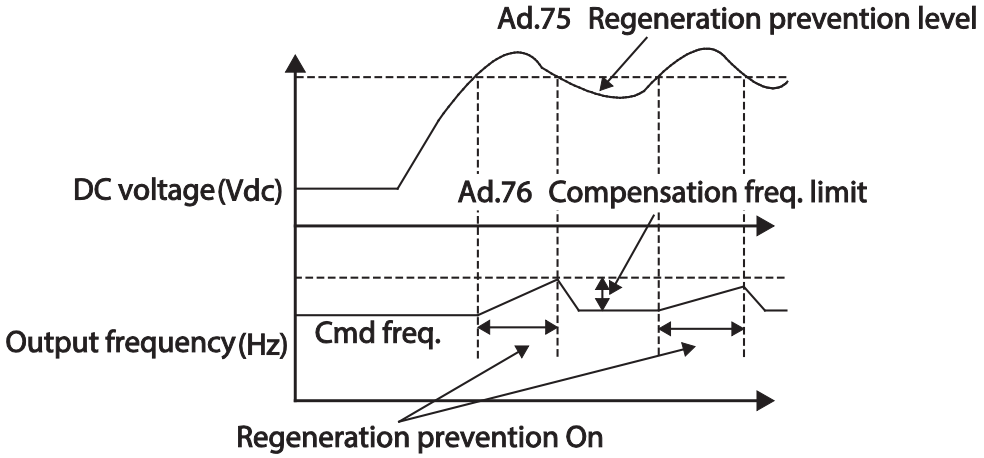
Press Regeneration Prevention

Press regeneration prevention is used during press operations to prevent braking during the regeneration process. If motor regeneration occurs during a press operation, motor operation speed automatically goes up to avoid the regeneration zone.

Pr. Group	Pr. Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
Ad	74	Select press regeneration prevention for press	RegenAvd Sel	0	No	0–1	–
	75	Press regeneration prevention operation voltage level	RegenAvd Level	350V		230V: 300–400V	VDC
				700V		460V: 600–800V	
	76	Press regeneration prevention compensation frequency limit	CompFreq Limit	1.00Hz		0.00– 10.00Hz	Hz
	77	Press regeneration prevention P gain	RegenAvd Pgain	50.0%		0 .0– 100.0%	%
	78	Press regeneration prevention I gain	RegenAvd Igain	500(ms)		20–30000ms	ms

Press Regeneration Prevention Setting Details

Pr. Code	Description
Ad.74 RegenAvd Sel	Frequent regeneration voltage from a press load during constant speed motor operation may force excessive work on the brake unit which may damage or shorten the brake life. To prevent this situation, select Ad.74 (RegenAvd Sel) to control DC link voltage and disable the brake unit operation.
Ad.75 RegenAvd Level	Set brake operation prevention level voltage when the DC link voltage goes up due to regeneration.
Ad.76 CompFreq Limit	Set alternative frequency width that can replace actual operation frequency during regeneration prevention.
Ad.77 RegenAvd Pgain, Ad.78 RegenAvd Igain	To prevent regeneration zone, set P gain/I gain in the DC link voltage supress PI controller.



NOTE: Press regeneration prevention does not operate during accelerations or decelerations, but it only operates during constant speed motor operation. When regeneration prevention is activated, output frequency may change within the range set at Ad.76 (CompFreq Limit).

Analog Output

An analog output terminal provides output of 0–10V voltage, 4–20 mA current, or 0–32 kHz pulse.

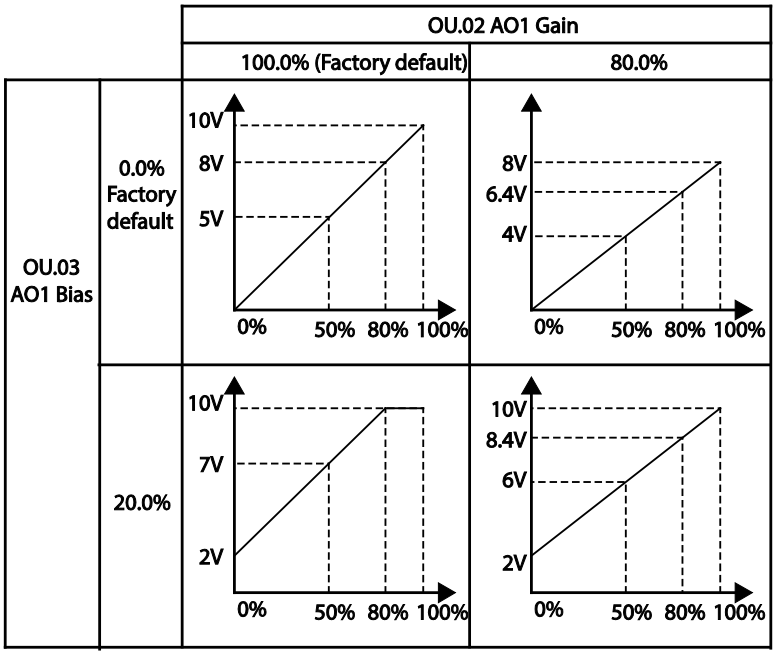
Voltage and Current Analog Output

An output type can be adjusted by selecting an output option at AO(Analog Output) terminal. Set the analog voltage/current output terminal setting switch (SW3) to change the output type (voltage/current).

Pr. Group	Pr. Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
OU	01	Analog output1	AO1 Mode	0	Frequency	0–15	–
	02	Analog output1 gain	AO1 Gain	100.0		–1000.0–1000.0	%
	03	Analog output1 bias	AO1 Bias	0.0		–100.0–100.0	%
	04	Analog output1 filter	AO1 Filter	5		0–10000	ms
	05	Analog constant output1	AO1 Const %	0.0		0.0–100.0	%
	06	Analog output1 monitor	AO1 Monitor	0.0		0.0–1000.0	%

Voltage and Current Analog Output Setting Details

Pr. Code	Description		
OU.1 AO1 Mode	Select a constant value for output. The following example for output voltage setting.		
	Setting		Function
	0	Frequency	Outputs operation frequency as a standard. 10V output is made from the frequency set at dr.20(Max Freq)
	1	Output Current	10V output is made from 200% of drive rated current.
	2	Output Voltage	Sets the outputs based on the drive output voltage. 10V output is made from a set voltage in bA.15 (Rated V). If 0V is set in bA.15, 230V/460V models output 10V based on the actual input voltages (240V and 480V respectively).
	3	DC Link Volt	Outputs drive DC link voltage as a standard. Outputs 10V when the DC link voltage is 410Vdc for 230V models, and 820Vdc for 460V models.
	4	Torque	Outputs the generated torque as a standard. Outputs 10V at 250% of motor rated torque.
	5	Ouput Power	Monitors output wattage. 200% of rated output is the maximum display voltage (10V).
	6	Iqse	Outputs the maximum voltage at 200% of no load current.
	7	Idr.	Outputs the maximum voltage at 250% of rated torque current $rated\ torque\ current = \sqrt{rated\ current^2 - no\ load\ current^2}$
	8	Target Freq	Outputs set frequency as a standard. Outputs 10V at the maximum frequency (dr.20).
	9	Ramp Freq	Outputs frequency calculated with Acc/Dec function as a standard. May vary with actual output frequency. Outputs 10V.
	12	PID Ref Value	Outputs command value of a PID controller as a standard. Outputs approximately 6.6 V at 100%.
	13	PID Fdk Value	Outputs feedback volume of a PID controller as a standard. Outputs approximately 6.6 V at 100%.
	14	PID Output	Outputs output value of a PID controller as a standard. Outputs approximately 10V at 100%.
	15	Constant	Outputs OU.5 (AO1 Const %) value as a standard.

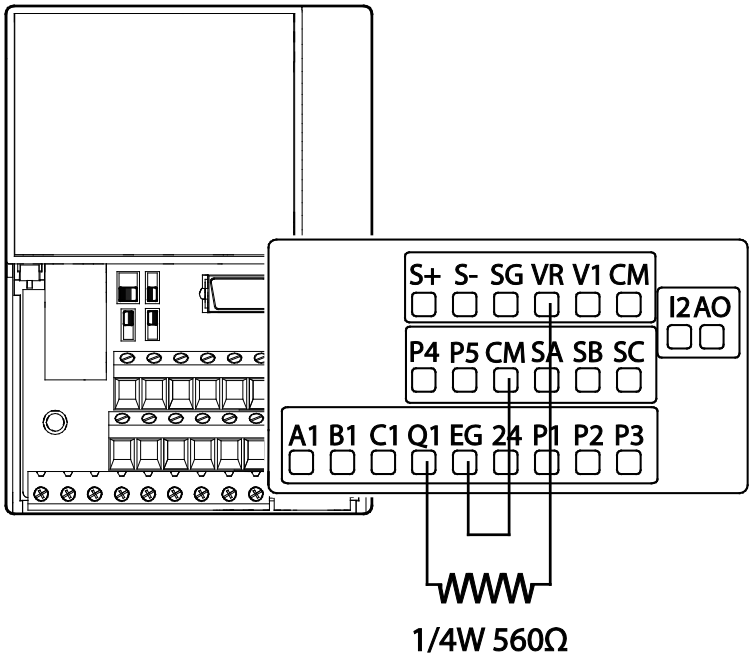
Pr. Code	Description
OU.2 AO1 Gain, OU.3 AO1 Bias	Adjusts output value and offset. If frequency is selected as an output item, it will operate as shown below. $$AO1 = \frac{Frequency}{MaxFreq} \times AO1\ Gain + AO1\ Bias$$ The graph below illustrates the analog voltage output (AO1) changes depend on OU.2 (AO1 Gain) and OU.3 (AO1 Bias) values. Y–axis is analog output voltage (0–10V), and X–axis is % value of the output item. Example, if the maximum frequency set at dr.20 (Max Freq) is 60Hz and the present output frequency is 30Hz, then the x–axis value on the next graph is 50%. 
OU.4 AO1 Filter	Set filter time constant on analog output.
OU.5 A01 Const %	If analog output at OU.1 (AO1 Mode) is set to 15(Constant), the analog voltage output is dependent on the set parameter values (0–100%).
OU.6 AO1 Monitor	Monitors analog output value. Displays the maximum output voltage as a percentage (%) with 10V as the standard.

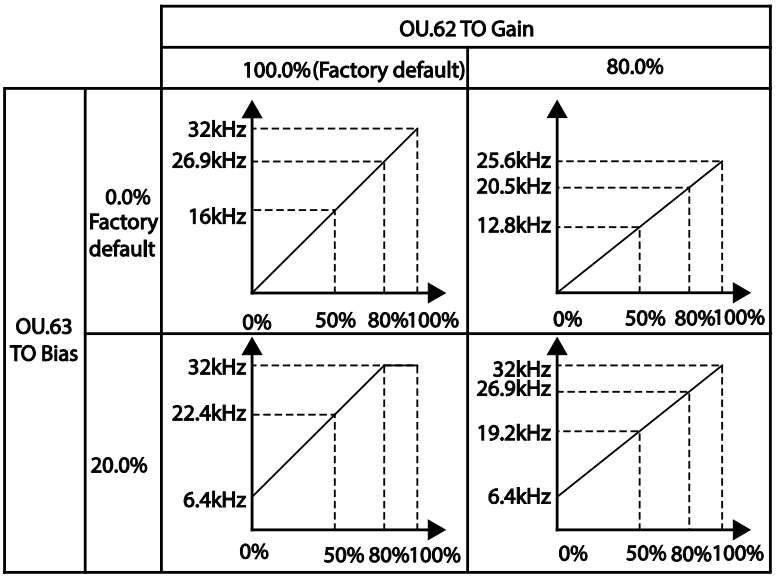
Analog Pulse Output

Output item selection and pulse size adjustment can be made for the Q1 terminal when configured as TO (Pulse Output).

Pr. Group	Pr. Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
OU	33	Multi–function output 1	Q1 define	39	TO	0–38	–
	61	Pulse output setting	TO Mode	0	Frequency	0–15	–
	62	Pulse output gain	TO Gain	100.0		–1000.0–1000.0	%
	63	Pulse output bias	TO Bias	0.0		–100.0–100.0	%
	64	Pulse output filter	TO Filter	5		0–10000	ms
	65	Pulse output constant output2	TO Const %	0.0		0.0–100.0	%
	66	Pulse output monitor	TO Monitor	0.0		0.0–1000.0	%

Analog Pulse Output Setting Details

Pr. Code	Description
OU.33 Q1 Define	Pulse output TO and multi–function output Q1 share the same terminal. Set OU.33 to 32kHz pulse output and follow the instructions below to make wiring connections that configure the open collector output circuit. 1) Connect a 1/4W, 560Ω resistor between VR and Q1 terminals. 2) Connect EG and CM terminals. When wiring the resistor, a resistance of 560Ω or less is recommended to stably provide 32kHz pulse output.  Connect a pulse between ACN drives as follows: ***ACN Drive #1 Output Terminal*** → ***ACN Drive #2 Input Terminal*** Q1 → P5 EG → CM

Pr. Code	Description
OU.62 TO Gain, OU.63 TO Bias	Adjusts output value and offset. If frequency is selected as an output, it will operate as shown below. $$TO = \frac{Frequency}{MaxFreq} \times TO\ Gain + TO\ Bias$$ The following graph illustrates that the pulse output (TO) changes depend on OU.62 (TO Gain) and OU.63 (TO Bias) values. The Y–axis is an analog output current(0–32kHz), and X–axis is % value on output item. For example, if the maximum frequency set with dr.20 (Max Freq) is 60Hz and present output frequency is 30Hz, then the x–axis value on the next graph is 50%. 
OU.64 TO Filter	Sets filter time constant on analog output.
OU.65 TO Const %	If analog output item is set to constant, the analog pulse output is dependent on the set parameter values.
OU.66 TO Monitor	Monitors analog output value. Displays the maximum output pulse (32kHz) as a percentage (%) of the standard.

Digital Output

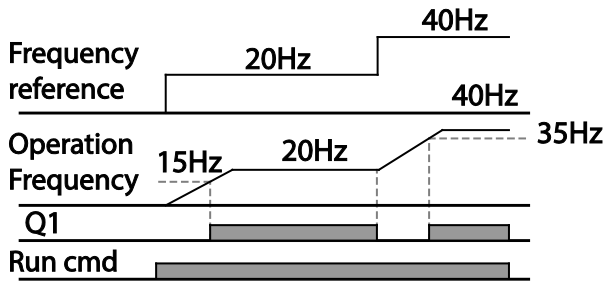
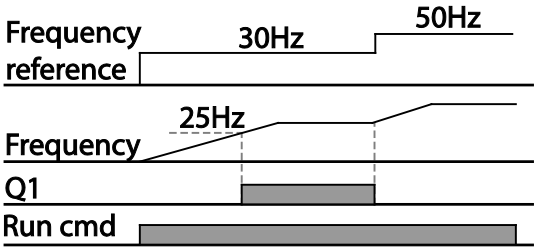
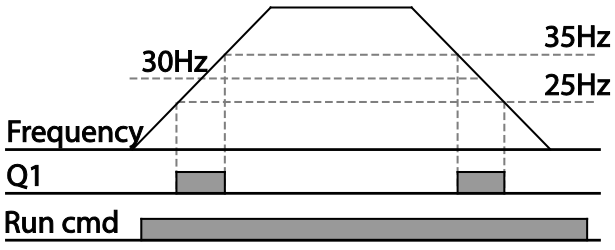
Multi–function Output Terminal and Relay Settings

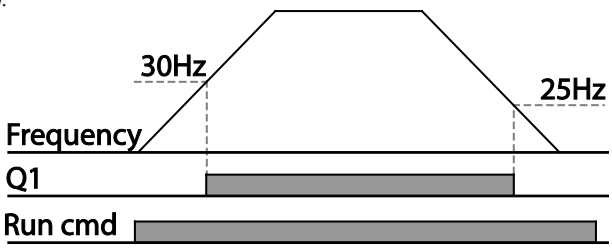
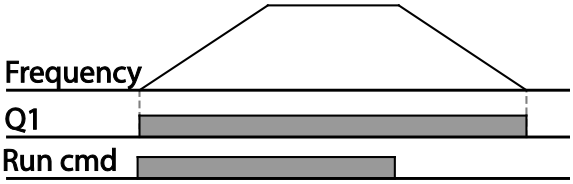
Pr. Group	Pr. Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
OU	30	Fault output item	Trip Out Mode	010*		–	bit
	31	Multi–function relay1 setting	Relay 1	29	Trip	–	–
	33	Multi–function output1 setting	Q1 Define	14	Run	–	–
	34	Multi-function relay3 setting	Relay 3	00	None	–	–
	35	Multi-function relay4 setting	Relay 4	00	None	–	–
	41	Multi–function output monitor	DO Status	–		00– 11	bit
	57	Detection frequency	FDT Frequency	30.00		0.00–Maximum frequency	Hz
	58	Detection frequency band	FDT Band	10.00			

**See "Bit Selection" on page 4–3 for details*

Multi–function Output Terminal and Relay Setting Details

Pr. Code	Description
OU.31 Relay1	Set Relay1 output options (See Table Below).
OU.33 Q1 Define	Select output options for multi–function output terminal (Q1). Q1 is open collector TR output.
OU.34 ***OU.35***	Set Relay output options for extension IO card (See Table Below).
OU.57 FDT Freq ***OU.58 FDT Band***	Set output terminal and relay functions according to OU.57 FDT (Frequency), OU.58 (FDT Band) settings and fault trip conditions (see table below).

Digital Output OU.31, OU.33, OU.34, OU.35 Functions		
Setting		Function
0	None	No output signal.
1	FDT–1	Detects drive output frequency reaching the user set frequency. Outputs a signal when the absolute value (set frequency–output frequency) < detected frequency width/2. When detected frequency width is 10Hz, FDT–1 output is as shown in the graph below. 
2	FDT–2	Outputs a signal when the user set frequency and detected frequency (FDT Frequency) are equal, and fulfills FDT–1 condition at the same time. [Absolute value (set frequency–detected frequency) < detected frequency width/2]&[FDT–1] Detected frequency width is 10Hz. When the detected frequency is set to 30Hz, FDT–2 output is as shown in the graph below. 
3	FDT–3	Outputs a signal when the Absolute value (output frequency–operation frequency) < detected frequency width/2. Detected frequency width is 10Hz. When detected frequency is set to 30Hz, FDT–3 output is as shown in the graph below. 

Digital Output OU.31, OU.33, OU.34, OU.35 Functions		
Setting		**Function**
4	FDT–4	Output signal can be separately set for acceleration and deceleration conditions. • In acceleration: Operation frequency≥Detected frequency • In deceleration: Operation frequency>(Detected frequency–Detected frequency width/2) Detected frequency width is 10Hz. When detected frequency is set to 30Hz, FDT–4 output is as shown in the graph below. 
5	Overload	Outputs a signal at motor overload.
6	IOL	Outputs a signal when a fault is triggered from a protective function operation by drive overload inverse proportion.
7	Underload	Outputs a signal at load fault warning.
8	Fan Warning	Outputs a signal at fan fault warning.
9	Stall	Outputs a signal when a motor is overloaded and stalled.
10	Over voltage	Outputs a signal when the drive DC link voltage rises above the protective operation voltage.
11	Low Voltage	Outputs a signal when the drive DC link voltage drops below the low voltage protective level.
12	Over Heat	Outputs signal when the drive overheats.
13	Lost command	Outputs a signal when there is a loss of analog input terminal and RS–485 communication command at the terminal block. Outputs a signal when communication power and expansion an I/O power card is installed, and also outputs a signal when losing analog input and communication power commands.
14	RUN	Outputs a signal when operation command is entered and the drive outputs voltage. No signal output during DC braking. 
15	Stop	Outputs a signal at operation command off, and when there is no drive output voltage.
16	Steady	Outputs a signal in steady operation.
17	Drive line	Outputs a signal while the motor is driven by the drive line.
18	Comm line	Outputs a signal while the motor is driven by a commercial power source. For details, refer to "Supply Power Transition" on page 4–175.
19	Speed search	Outputs a signal during drive speed search operation. For details, refer to "Speed Search Operation" on page 4–169.
22	Ready	Outputs signal when the drive is in stand by operation and ready to receive an external operation command.
28	Timer Out	A timer function to operate terminal output after a certain time by using multi–function terminal block input. For more details, refer to "Multi-function IO Timer Settings" on page 4–183.
29	Trip	Outputs a signal after a fault trip Refer to "Multi–function Output On/Off Control Setting Details" on page 4–185.
31	DB Warn %ED	Refer to "Dynamic Braking" on page 4–207.
34	On/Off Control	Outputs a signal using an analog input value as a standard. Refer to "Multi–function Output On/Off Control Setting Details" on page 4–185.

Digital Output OU.31, OU.33, OU.34, OU.35 Functions		
Setting		Function
35	BR Control	Outputs a brake release signal. Refer to "Brake Control" on page 4–184.
40	KEB Operating	This outputs when the energy buffering operation is started because of low voltage of the drive's DC power section due to a power failure on the input power. (This outputs in the energy buffering state before the input power restoration regardless of KEB–1 and KEB–2 mode settings.)

Fault Trip Output using Multi–Function Output Terminal and Relay

The drive can output fault trip state using multi–function output terminal (Q1) and relay (Relay 1).

Pr. Group	Pr. Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
OU	30	Fault trip output mode	Trip Out Mode	010		–	bit
	31	Multi–function relay1	Relay 1	29	Trip	–	–
	33	Multi–function output1	Q1 Define	14	Run	–	–
	34	Multi-function relay3 setting	Relay 3	29	Trip	–	–
	35	Multi-function relay4 setting	Relay 4	29	Trip	–	–
	53	Fault trip output on delay	TripOut OnDly	0.00		0.00–100.00	sec
	54	Fault trip output off delay	TripOut OffDly	0.00		0.00–100.00	sec

Fault Trip Output by Multi–function Output Terminal and Relay – Setting Details

Pr. Code	Description			
OU.30 Trip Out Mode	Fault trip relay operates based on the fault trip output settings. When a fault trip occurs in the drive, the relevant terminal and relay will operate. Depending on the fault trip type, terminal and relay operation can be configured as shown in the table below. *See "Bit Selection" on page 4–3 for details.			
	Setting			Function
	bit3	bit2	bit1	
			X	Operates when low voltage fault trips occur
		X		Operates when fault trips other than low voltage occur
	X			Operates when auto restart fails (Pr.8 and Pr.9)
OU.31 Relay1 ***OU.33 Q1 Define*** ***OU.34 Relay 3*** ***OU.35 Relay 4***	Select fault trip output terminal/relay and select 29 (Trip Mode) at codes OU.31 and OU.33. Set OU.34 and OU.35 if extension IO module is installed.			
OU.53 Trip Out On Dly, ***OU.54 Trip Out Off Dly***	If a fault trip occurs, trip relay or multi–function output operates after the time delay set in OU.53. Terminal is off with the input initialized after the time delay set in OU.54.			

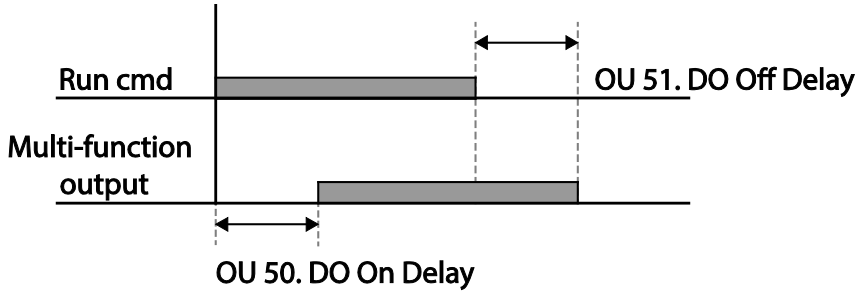
Multi–function Output Terminal Delay Time Settings

Set on–delay and off–delay times separately to control the output terminal and relay operation times. The delay time set at codes OU.50–51 applies to multi–function output terminal (Q1) and relay (Relay 1), except when the multi–function output function is in fault trip mode.

Pr. Group	Pr. Code	Name	LCD Display	Parameter Setting	Setting Range	Unit
OU	50	Multi–function output On delay	DO On Delay	0.00	0.00–100.00	s
	51	Multi–function output Off delay	DO Off Delay	0.00	0.00–100.00	s
	52	Select multi–function output terminal	DO NC/NO Sel	00*	00–11	bit
*See "Bit Selection" on page 4–3 for details						

Output Terminal Delay Time Setting Details

Pr. Code	Description
OU.52 DO NC/NO Sel	Select terminal type for relay and multi–function output terminal. An additional three terminal type selection bits at the terminal block will be added when an expansion I/O is added. By setting the relevant bit to 0, it will operate A terminal (Normally Open), and setting it to 1 will operate B terminal (Normally Closed). Shown below in the table are Relay 1 and Q1 settings starting from the right bit.



Keypad Language Settings

Select the language to be displayed on the LCD keypad.

Pr. Group	Pr. Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
CNF*	01	Select keypad language	Language Sel	0	English	–	–
				1	Korean		
*Available on ACN-LCD keypad only.							

Operation State Monitor

The drive's operation condition can be monitored using the LCD keypad. If the monitoring option is selected in config (CNF) mode, a maximum of four items can be monitored simultaneously. Monitoring mode displays three different items on the LCD keypad, but only one item can be displayed in the status window at a time.

Pr. Group	Pr. Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
CNF*	20	Display item condition display window	Anytime Para	0	Frequency	–	–
	21	Monitor mode display 1	Monitor Line–1	0	Frequency	–	Hz
	22	Monitor mode display 2	Monitor Line–2	2	Output Current	–	A
	23	Monitor mode display 3	Monitor Line–3	3	Output Voltage	–	V
	24	Monitor mode initialize	Mon Mode Init	0	No	–	–

**Available on ACN-LCD keypad only.*

Operation State Monitor Setting Details

Pr. Code	Description		
CNF.20 AnyTime Para	Select items to display on the top–right side of the LCD keypad screen. Choose the parameter settings based on the information to be displayed. Codes CNF.20–23 share the same setting options as listed in the table below.		
	Setting		Function
	0	Frequency	On stop, displays the set frequency. During operation, displays the actual output frequency (Hz).
	1	Speed	On stop, displays the set speed (rpm). During operation, displays the actual operating speed (rpm).
	2	Output Current	Displays output current.
	3	Output Voltage	Displays output voltage.
	4	Output Power	Displays output power.
	5	WHour Counter	Displays drive power consumption.
	6	DCLink Voltage	Displays DC link voltage within the drive.
	7	DI Status	Displays input terminal status of the terminal block. Starting from the right, displays P1–P5.
	8	DO Status	Displays output terminal status of the terminal block. Starting from the right, Relay1, Relay2, and Q1.
	9	V1 MonitorV	Displays the input voltage value at terminal V1 (V).
	10	V1 Monitor%	Displays input voltage terminal V1 value as a percentage. If –10V, 0V, +10V is measured, –100%, 0%, 100% will be displayed.
	13	V2 MonitorV	Displays input voltage terminal V2 value (V).
	14	V2 Monitor%	Displays input voltage terminal V2 value as a percentage.
	15	I2 Monitor[mA]	Displays input current terminal I2 value (A).
	16	I2 Monitor%	Displays input current terminal I2 value as a percentage.
	17	PID Output	Displays output of PID controller.
	18	PID Ref Value	Displays reference value of PID controller.
	19	PID Fdb Value	Displays feedback volume of PID controller.
	20	Torque	If the torque reference command mode (DRV–08) is set to a value other than keypad (0 or 1), the torque reference value is displayed.
	21	Torque Limit	If torque limit setting (Cn.53) is set to a value other than keypad (0 or 1), the torque limit value is displayed.
	23	Spd Limit	If the speed limit setting (Cn.62) on torque control mode is set to a value other than keypad (0 or 1), the speed limit setting is displayed.
	24	Load Speed	Displays the speed of a load in the desired scale and unit. Displays the speed of a load that ADV–61 (Load Spd Gain) and ADV–62 (Load Spd Scale) are applied as rpm or mpm set at ADV–63 (Load Spd Unit).
CNF.21–23 Monitor Line–x	Select the items to be displayed in monitor mode. Monitor mode is the first displayed mode when the drive is powered on. A total of three items, from monitor line–1 to monitor line– 3, can be displayed simultaneously.		
CNF.24 Mon Mode Init	Selecting 1(Yes) initializes CNF.20–23.		

Load Speed Display Setting

Pr. Group	Pr. Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
ADV (M2)	61(40)	Rotation count speed gain	Load Spd Gain	–	100.0	1–6000.0%	–
	62(41)	Rotation count speed scale	Load Spd Scale	0	x 1	0–4	Hz
	63(42)	Rotation count speed unit	Load Spd Unit	2	rpm	0–1	A

Load Speed Display Setting Detail

Pr. Code	Description
ADV.61 (M2.40) Load Spd Gain	If monitoring item 24 Load Speed is selected and if the motor spindle and the load are connected with belt, the actual number of revolutions can be displayed by calculating the pulley ratio.
ADV.62 (M2.41) Load Spd Scale	Selects the decimal places that monitoring item 24 Load Speed displays (from x1–x0.0001).
ADV.63 (M2.42) Load Spd Unit	Selects the unit of monitoring item 24 Load Speed. Selects between RPM (Revolution Per Minute) and MPM (Meter Per Minute) for the unit. For example, if line speed is 300 [mpm] at 800 [rpm], set ADV61 (Load Spd Gain) to "37.5%" to display the line speed. Also, set ADV62 (Load Sped Scale) to "X 0.1" to display the value to the first decimal point. And set ADV63 (Load Spd Unit) to mpm. Now, the monitoring item 24 Load Speed is displayed on the keypad display as 300.0 mpm instead of 800 rpm.

NOTE: Drive power consumption
Values are calculated using voltage and current. Electric power is calculated every second and the results are accumulated. Setting CNF.62 (WH Count Reset) value to 1(Yes) will reset cumulated electric energy consumption. Power consumption is displayed as shown below:

- *Less than 1, 000 kW: Units are in kW, displayed in 999.9 kW format.*
- *1-99 MW: Units are in MW, displayed in 99.99 MWh format.*
- *100-999 MW: Units are in MW, displayed in 999.9 MWh format.*
- *More than 1, 000 MW: Units are in MW, displayed in 9, 999 MWh format and can be displayed up to 65, 535 MW. (Values exceeding 65, 535MW will reset the value to 0, and units will return to kW. It will be displayed in 999.9 kW format).*

Operation Time Monitor

Monitors drive and fan operation time.

Pr. Group	Pr. Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
CNF*	70	Drive operation accumulated time	On–time	0/00/00 00: 00		–	min
	71	Drive operation accumulated time	Run–time	0/00/00 00: 00		–	min
	72	Drive operation accumulated time initialization	Time Reset	0	No	0–1	–
	74	Cooling fan operation accumulated time	Fan time	0/00/00 00: 00		–	min
	75	Cooling fan operation accumulated time initialization	Fan Time Reset	0	No	0–1	–

**Available on ACN-LCD keypad only.*

Operation Time Monitor Setting Details

Pr. Code	Description
CNF.70 On–time	Displays accumulated power supply time. Information is displayed in [YY/MM/DD Hr: Min (0/00/00 00: 00)] format.
CNF.71 Run–time	Displays accumulated time of voltage output by operation command input. Information is displayed in [YY/MM/DD Hr: Min (0/00/00 00: 00)] format.
CNF.72 Time Reset	Setting 1(Yes) will delete power supply accumulated time (On–time) and operation accumulated time (Run–time) and is displayed as 0/00/00 00: 00 format.
CNF.74 Fan time	Displays accumulated time of drive cooling fan operation. Information will be displayed in [YY/MM/DD Hr: Min (0/00/00 00: 00)] format.
CNF.75 Fan Time Reset	Setting 1(Yes) will delete cooling fan operation accumulated time(on–time) and operation accumulated time (Run–time) and will display it in 0/00/00 00: 00 format.

Learning Protection Features

Protection features provided by the ACN series drive are categorized into two types: protection from overheating damage to the motor, and protection against the drive malfunction.

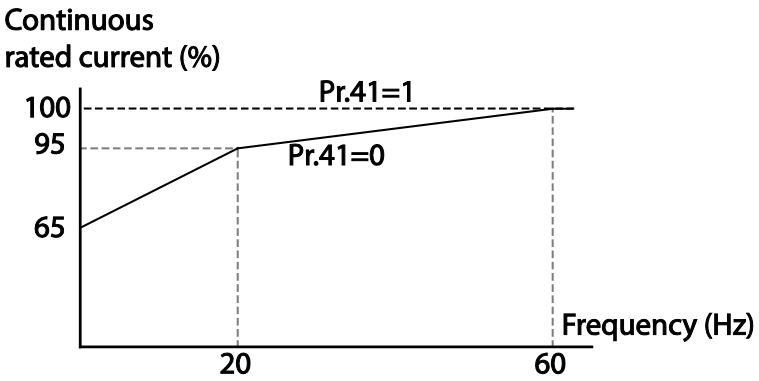
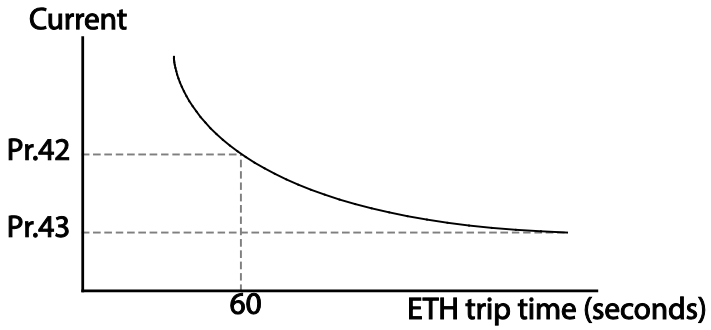
Motor Protection

Electronic Thermal Motor Overheating Prevention (ETH)

ETH is a protective function that uses the output current of the drive without a separate temperature sensor, to predict a rise in motor temperature to protect the motor based on its heat characteristics.

Pr. Group	Pr. Code	Name	LCD Display	Parameter Setting		Setting range	Unit
Pr	40	Electronic thermal prevention fault trip selection	ETH Trip Sel	0	None	0–2	–
	41	Motor cooling fan type	Motor Cooling	0	Self–cool	–	–
	42	Electronic thermal one minute rating	ETH 1min	150		120–200	%
	43	Electronic thermal prevention continuous rating	ETH Cont	120		50–150	%

Electronic Thermal (ETH) Prevention Function Setting Details

<table>
<tr><th>Pr. Code</th><th colspan="3">Description</th></tr>
<tr><td rowspan="5">Pr.40 ETH Trip Sel</td><td colspan="3">ETH can be selected to provide motor thermal protection. The LCD screen displays “E–Thermal.”</td></tr>
<tr><td>Setting</td><td colspan="2">Function</td></tr>
<tr><td>0</td><td>None</td><td>The ETH function is not activated.</td></tr>
<tr><td>1</td><td>Free–Run</td><td>The drive output is blocked. The motor coasts to a halt (free–run).</td></tr>
<tr><td>2</td><td>Dec</td><td>The drive decelerates the motor to a stop.</td></tr>
<tr><td rowspan="5">Pr.41 Motor Cooling</td><td colspan="3">Select the drive mode of the cooling fan, attached to the motor.</td></tr>
<tr><td>Setting</td><td colspan="2">Function</td></tr>
<tr><td>0</td><td>Self–cool</td><td>As the cooling fan is connected to the motor axis, the cooling effect varies, based on motor speed. Most universal induction motors have this design.</td></tr>
<tr><td>1</td><td>Forced–cool</td><td>Additional power is supplied to operate the cooling fan. This provides extended operation at low speeds. Motors designed for drives typically have this design.</td></tr>
<tr><td colspan="3"> 
</td></tr>
<tr><td>Pr.42 ETH 1 min</td><td colspan="3">The amount of input current that can be continuously supplied to the motor for 1 minute, based on the motor–rated current (bA.13).</td></tr>
<tr><td>Pr.43 ETH Cont</td><td colspan="3">Sets the amount of current with the ETH function activated. The range below details the set values that can be used during continuous operation without the protection function.
 
</td></tr>
</table>

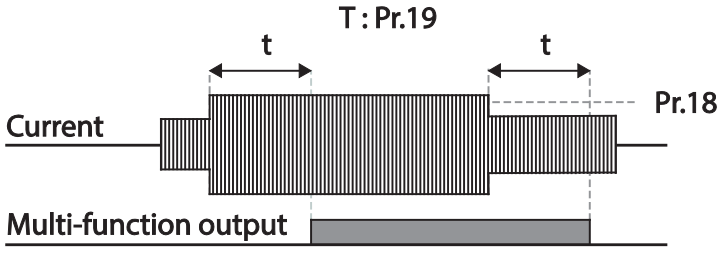
Overload Early Warning and Trip

A warning or fault 'trip' (cutoff) occurs when the motor reaches an overload state, based on the motor's rated current. The amount of current for warnings and trips can be set separately.

Pr. Group	Pr. Code	Name	LCD Display	Parameter Setting		Setting range	Unit
Pr	17	Overload warning selection	OL Warn Select	1	Yes	0–1	–
	18	Overload warning level	OL Warn Level	150		30–180	%
	19	Overload warning time	OL Warn Time	10.0		0–30	s
	20	Motion at overload trip	OL Trip Select	1	Free–Run	–	–
	21	Overload trip level	OL Trip Level	180		30–200	%
	22	Overload trip time	OL Trip Time	60.0		0–60.0	s
OU	31	Multi–function relay 1 item	Relay 1	5	Over Load	–	–
	33	Multi–function output 1 item	Q1 Define				

Overload Early Warning and Trip Setting Details

Pr. Coden	Description		
Pr.17 OL Warn Select	If the overload reaches the warning level, the terminal block multi–function output terminal and relay are used to output a warning signal. If 1 (Yes) is selected, it will operate. If 0 (No) is selected, it will not operate.		
Pr.18 OL Warn Level, Pr.19 OL Warn Time	When the input current to the motor is greater than the overload warning level (OL Warn Level) and continues at that level during the overload warning time (OL Warn Time), the multi–function output (Relay 1, Q1) sends a warning signal. When Over Load is selected at OU.31 and 33, the multi–function output terminal or relay outputs a signal. The the signal output does not block the drive output.		
Pr.20 OL Trip Select	Select the drive protective action in the event of an overload fault trip.		
	Setting		Function
	0	None	No protective action is taken.
	1	Free–Run	In the event of an overload fault, drive output is blocked and the motor will free–run due to inertia.
	2	Dec	If a fault trip occurs, the motor decelerates and stops.
Pr.21 OL Trip Level, Pr.22 OL Trip Time	When the current supplied to the motor is greater than the preset value at the overload trip level (OL Trip Level) and continues to be supplied during the overload trip time (OL Trip Time), the drive output is either blocked according to the preset mode from Pr. 17 or slows to a stop after deceleration.		



NOTE: Overload warnings warn of an overload before an overload fault trip occurs. The overload warning signal may not work in an overload fault trip situation, if the overload warn level (OL Warn Level) and the overload warn time (OL Warn Time) are set higher than the overload trip level (OL Trip Level) and overload trip time (OL Trip Time).

Stall Prevention and Flux Braking

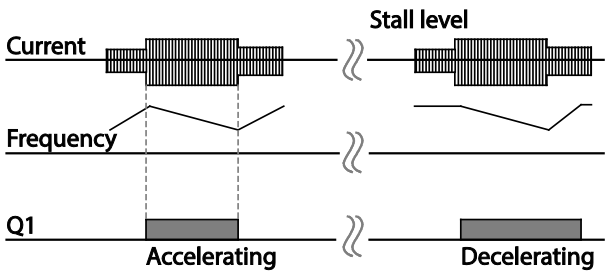
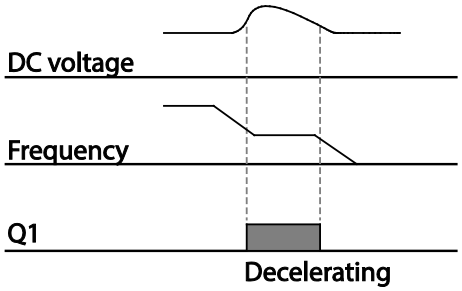
The stall prevention function is a protective function that prevents motor stall caused by overloads. If a motor stall occurs due to an overload, the drive operation frequency is adjusted automatically. When stall is caused by overload, high currents are induced in the motor may cause motor overheat or damage the motor and interrupt operation of the motor–driven devices.

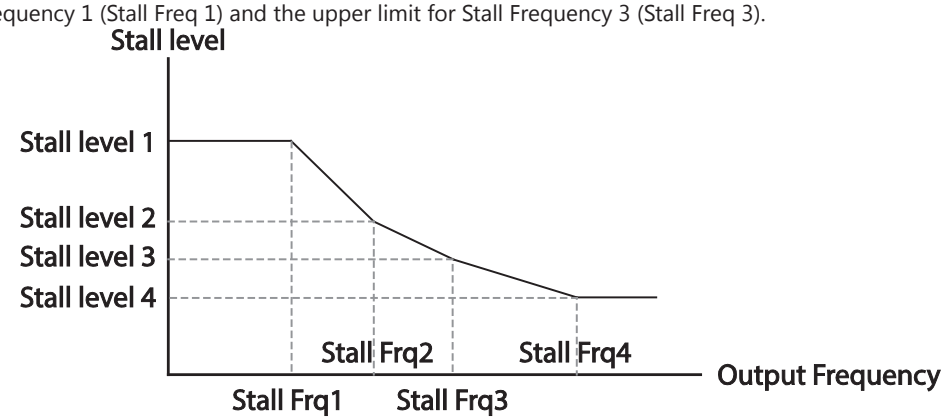
To protect the motor from overload faults, the drive output frequency is adjusted automatically, based on the size of load.

Pr. Group	Pr. Code	Name	LCD Display	Parameter Setting		Setting range	Unit
Pr	50	Stall prevention and flux braking	Stall Prevent	0000*		–	bit
	51	Stall frequency 1	Stall Freq 1	60.00		Start frequency–Stall Freq 1	Hz
	52	Stall level 1	Stall Level 1	180		30–250	%
	53	Stall frequency 2	Stall Freq 2	60.00		Stall Freq 1–Stall Freq 3	Hz
	54	Stall level 2	Stall Level 2	180		30–250	%
	55	Stall frequency 3	Stall Freq 3	60.00		Stall Freq 2–Stall Freq 4	Hz
	56	Stall level 3	Stall Level 3	180		30–250	%
	57	Stall frequency 4	Stall Freq 4	60.00		Stall Freq 3–Maximum frequency	Hz
	58	Stall level 4	Stall Level 4	180		30–250	%
OU	31	Multi–function relay 1 item	Relay 1	9	Stall	–	–
	33	Multi–function output 1 item	Q1 Define				

**See "Bit Selection" on page 4–3 for details*

Stall Prevention Function and Flux Braking Setting Details

<table>
<tr><th>Pr. Code</th><th colspan="3">Description</th></tr>
<tr><td rowspan="8">Pr.50 Stall Prevent</td><td colspan="3">Stall prevention can be configured for acceleration, deceleration, or while operating a motor at constant speed. When the top LCD segment is on, the corresponding bit is set. When the bottom LCD segment is on, the corresponding bit is off.. *See "Bit Selection" on page 4–3 for details</td></tr>
<tr><td colspan="2">Setting</td><td>Function</td></tr>
<tr><td>0001</td><td>Stall protection during acceleration</td><td>If drive output current exceeds the preset stall level (Pr.52, 54, 56, 58) during acceleration, the motor stops accelerating and starts decelerating. If current level stays above the stall level, the motor decelerates to the start frequency (dr.19). If the current level causes deceleration below the preset level while operating the stall protection function, the motor resumes acceleration.</td></tr>
<tr><td>0010</td><td>Stall protection while operating at constant speed</td><td>Similar to stall protection function during acceleration, the output frequency automatically decelerates when the current level exceeds the preset stall level while operating at constant speed. When the load current decelerates below the preset level, it resumes acceleration.</td></tr>
<tr><td>0100</td><td>Stall protection during deceleration</td><td>The drive decelerates and keeps the DC link voltage below a certain level to prevent an over voltage fault trip during deceleration. As a result, deceleration times can be longer than the set time depending on the load.</td></tr>
<tr><td>1000</td><td>Flux braking during deceleration</td><td>When using flux braking, deceleration time may be reduced because regenerative energy is expended at the motor.</td></tr>
<tr><td>1100</td><td>Stall protection and flux braking during deceleration</td><td>Stall protection and flux braking operate together during deceleration to achieve the shortest and most stable deceleration performance.</td></tr>
<tr><td colspan="3"> 
</td></tr>
<tr><td colspan="3"> 
</td></tr>
</table>

Pr. Code	Description
Pr.51 Stall Freq 1– Pr.58 Stall Level 4	Additional stall protection levels can be configured for different frequencies, based on the load type. As shown in the graph below, the stall level can be set above the base frequency. The lower and upper limits are set using numbers that correspond in ascending order. For example, the range for Stall Frequency 2 (Stall Freq 2) becomes the lower limit for Stall Frequency 1 (Stall Freq 1) and the upper limit for Stall Frequency 3 (Stall Freq 3). 

NOTE: Stall protection and flux braking operate together only during deceleration. Turn on the third and fourth bits of Pr.50 (Stall Prevention) to achieve the shortest and most stable deceleration performance without triggering an overvoltage fault trip for loads with high inertia and short deceleration times. Do not use this function when frequent deceleration of the load is required, as the motor can overheat and may be damaged easily.
When operating Brake resistor, the motor may vibrate under the Flux braking operation. In this case, please turn off the Flux braking (Pr.50).

CAUTION: Use caution when decelerating while using stall protection as depending on the load, the deceleration time can take longer than the time set. Acceleration stops when stall protection operates during acceleration. This may make the actual acceleration time longer than the preset acceleration time. When the motor is operating, Stall Level 1 applies and determines the operation of stall protection.

Drive and Sequence Protection

Open–phase Protection

Open–phase protection is used to prevent overcurrent levels induced at the drive inputs due to an open–phase within the input power supply. Open–phase output protection is also available. An open–phase at the connection between the motor and the drive output may cause the motor to stall, due to a lack of torque.

Pr. Group	Pr. Code	Name	LCD Display	Parameter Setting	Setting range	Unit
Pr	05	Input/output open–phase protection	Phase Loss Chk	00*	–	bit
	06	Open–phase input voltage band	IPO V Band	40	1–100V	V
**See "Bit Selection" on page 4–3 for details*						

Input and Output Open–phase Protection Setting Details

Pr. Code	Description		
Pr.5 Phase Loss Chk, Pr.6 IPO V Band	When open–phase protection is operating, input and output configurations are displayed differently. When the top LCD segment is On, the corresponding bit is set to On. When the bottom LCD segment is On, the corresponding bit is set to Off. *See "Bit Selection" on page 4–3 for details		
	Setting		Function
	Bit 2	Bit 1	
		X	Output open–phase protection
	X		Input open–phase protection

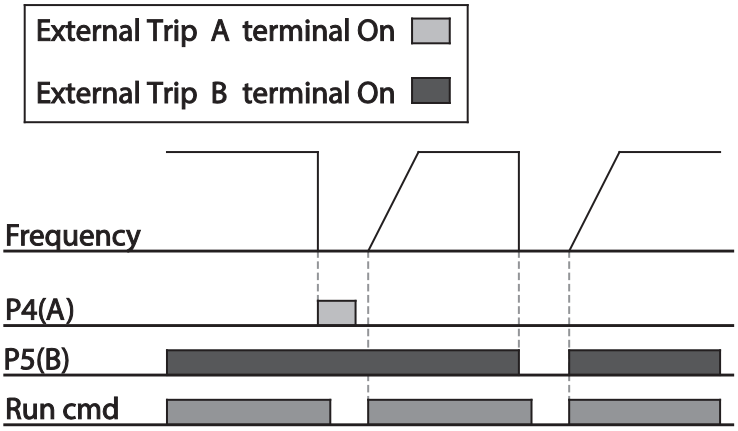
External Trip Signal

Set one of the multi–function input terminals to 4 (External Trip) to allow the drive to stop operation when abnormal operating conditions arise.

Pr. Group	Pr. Code	Name	LCD Display	Parameter Setting		Setting range	Unit
In	65–69	Px terminal setting options	Px Define (Px: P1–P5)	4	External Trip	0–54	–
	87	Multi–function input contact selction	DI NC/NO Sel	00000*		–	bit
**See "Bit Selection" on page 4–3 for details*							

External Trip Signal Setting Details

Pr. Code	Description											
In.87 DI NC/NO Sel	Selects the type of input contact. If the mark of the switch is at the bottom (0), it operates as an A contact (Normally Open). If the mark is at the top (1), it operates as a B contact (Normally Closed). The corresponding terminals for each bit are as follows:											
	Bit	11	10	9	8	7	6	5	4	3	2	1
	Terminal							P5	P4	P3	P2	P1



Drive Overload Protection

When the drive input current exceeds the rated current, a protective function is activated to prevent damages to the drive based on inverse proportional characteristics.

Pr. Group	Pr. Code	Name	LCD Display	Parameter Setting		Setting range	Unit
OU	31	Multi–function relay 1	Relay 1	6	IOL	–	–
	33	Multi–function output 1	Q1 Define				

NOTE: A warning signal output can be provided in advance by the multi-function output terminal before the drive overload protection function (IOLT) operates. When the overcurrent time reaches 60% of the allowed overcurrent (150%, 1 min), a warning signal output is provided (signal output at 150%, 36sec).

Speed Command Loss

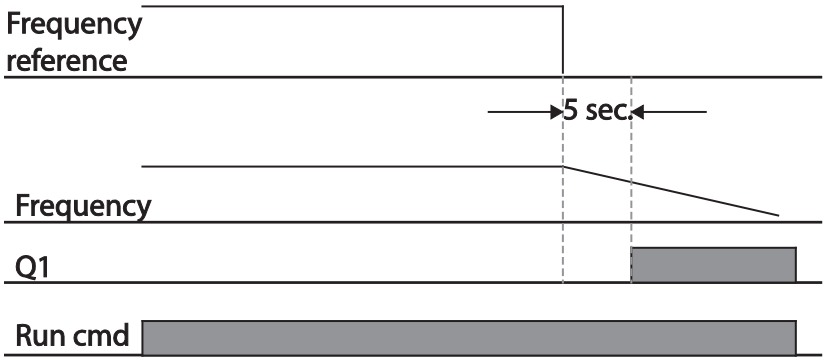
When setting operation speed using an analog input at the terminal block, communication options, or the keypad, speed command loss setting can be used to select the drive operation for situations when the speed command is lost due to the disconnection of signal cables.

Pr. Group	Pr. Code	Name	LCD Display	Parameter Setting		Setting range	Unit
Pr	12	Speed command loss operation mode	Lost Cmd Mode	1	Free–Run	–	–
	13	Time to determine speed command loss	Lost Cmd Time	1.0		0.1–120	s
	14	Operation frequency at speed command loss	Lost Preset F	0.00		Start frequency–Max. frequency	Hz
	15	Analog input loss decision level	AI Lost Level	0	Half of x1	–	–
OU	31	Multi–function Relay 1	Relay 1	13	Lost Command	–	–
	33	Multi–function output 1	Q1 Define				

Speed Command Loss Setting Details

Pr. Code	Description		
Pr.12 Lost Cmd Mode	In situations when speed commands are lost, the drive can be configured to operate in a specific mode:		
	Setting		Function
	0	None	The speed command immediately becomes the operation frequency without any protection function.
	1	Free–Run	The drive blocks output. The motor performs in free–run condition.
	2	Dec	The motor decelerates and then stops at the time set at Pr.7 (Trip Dec Time).
	3	Hold Input	The drive calculates the average input value for 10 seconds before the loss of the speed command and uses it as the speed reference.
	4	Hold Output	The drive calculates the average output value for 10 seconds before the loss of the speed command and uses it as the speed reference.
	5	Lost Preset	The drive operates at the frequency set at Pr. 14 (Lost Preset F).
Pr.15 AI Lost Level, Pr.13 Lst Cmd Time	Configure the voltage and decision time for speed command loss when using analog input.		
	Setting		Function
	0	Half of x1	Based on the values set at In.8 and In.12, protective operation starts when the input signal is reduced to half of the initial value of the analog input set using the speed command (Frq code of Operation group) and it continues for the time (speed loss decision time) set at Pr. 13 (Lost Cmd Time). For example, set the speed command to 2 (V1) at the Frq code in the Operation group, and In.6 (V1 Polarity) to 0 (Unipolar). When the voltage input drops to less than half of the value set at In.8 (V1 Volt x 1), the protective function is activated.
	1	Below x1	The protective operation starts when the signal becomes smaller than the initial value of the analog input set by the speed command and it continues for the speed loss decision time set at Pr.13 (Lost Cmd Time). Codes In.8 and In.12 are used to set the standard values.
Pr.14 Lost Preset F	In situations where speed commands are lost, set the operation mode (Pr.12 Lost Cmd Mode) to 5 (Lost Preset). This operates the protection function and sets the frequency so that the operation can continue.		

Set Pr.15 (Al Lost Level) to 1 (Below x 1), Pr.12 (Lost Cmd Mode) to 2 (Dec), and Pr.13 (Lost Cmd Time) to 5 sec. Then it operates as follows:



NOTE: If speed command is lost while using communication options or the integrated RS-485 communication, the protection function operates after the command loss decision time set at Pr.13 (Lost Cmd Time) is passed.

Dynamic Braking

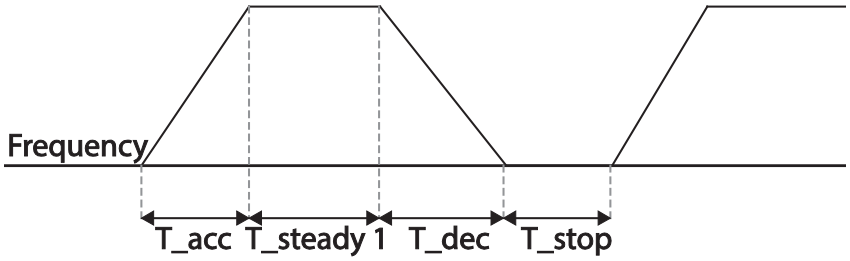
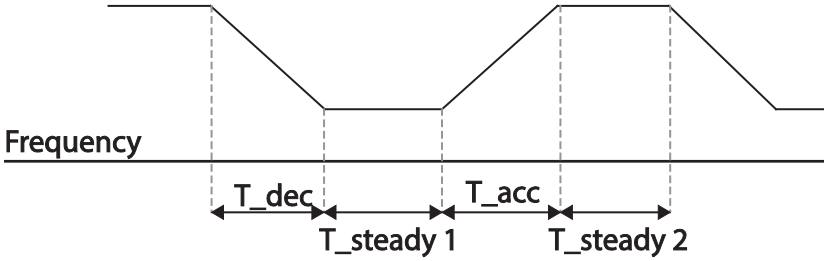
Dynamic Braking (DB) Resistor Configuration

For ACN series, the braking resistor circuit is integrated inside the drive. For Dynamic braking with external resistor, set the desired turn on level with AD.79. Ensure AD.74=0. Monitor the DC bus voltage on the main screen by dCL and check voltage on terminals P2/B to verify activation to brake resistor

Pr.66 is for setup of a warning signal if the braking is being used too frequently.

Pr. Group	Pr. Code	Name	LCD Display	Parameter Setting		Setting range	Unit
Ad	79	Dynamic Braking (DB) Unit turn on voltage level	DB Turn on Lev	230V: 390 460V: 780		230V: 350–400 460V: 600–800	V
Pr	66	Braking resistor configuration	DB Warn %ED	10		0–30	%
OU	31	Multi–function relay 1 item	Relay 1	31	DB Warn %ED	–	–
	33	Multi–function output 1 item	Q1 Define				

Dynamic Breaking Resistor Setting Details

Pr. Code	Description
Pr.66 DB Warn %ED	Set braking resistor configuration (%ED: Duty cycle). Braking resistor configuration sets the rate at which the braking resistor operates for one operation cycle. The maximum time for continuous braking is 15 sec and the braking resistor signal is not output from the drive after the 15 sec period has expired. An example of braking resistor set up is as follows: $$\%ED = \frac{T\_dec}{T\_acc + T\_steady + T\_dec + T\_stop} \times 100\%$$  **Example 1** $$\%ED = \frac{T\_dec}{T\_dec + T\_steady1 + T\_acc + T\_steady2} \times 100\%$$  **Example 2** • T_acc: Acceleration time to set frequency • T_steady: Constant speed operation time at set frequency • T_dec: Deceleration time to a frequency lower than constant speed operation or the stop time from constant speed operation frequency • T_stop: Stop time until operation resumes

CAUTION: Do not set the braking resistor to exceed the resistor's power rating. If overloaded, it can overheat and cause a fire. When using a resistor with a heat sensor, the sensor output can be used as an external trip signal for the drive's multi–function input.

Under load Fault Trip and Warning

Pr. Group	Pr. Code	Name	LCD Display	Parameter Setting		Setting range	Unit
Pr	25	Under load warning selection	UL Warn Sel	1	Yes	0–1	–
	26	Under load warning time	UL Warn Time	10.0		0–600	sec
	27	Under load trip selection	UL Trip Sel	1	Free–Run	–	–
	28	Under load trip timer	UL Trip Time	30.0		0–600	sec
	29	Under load upper limit level	UL LF Level	30		10–100	%
	30	Under load lower limit level	UL BF Level	30		10–100	%

Under Load Trip and Warning Setting Details

Pr. Code	Description
Pr.27 UL Trip Sel	Sets the underload fault trip occurs. If set to 0(None), does not detect the underload fault trip. If set to 1 (Free–Run), the output is blocked in an underload fault trip situation. If set to 2 (Dec), the motor decelerates and stops when an underload trip occurs.
Pr.25 UL Warn Sel	Sets the underload warning options. Set to 1(Yes) and set the multi–function output terminals (at OU.31 and 33) to 7 (Underload). The warning signals are output when an underload condition arises.
Pr.26 UL Warn Time, Pr.28 UL Trip Time	The protection function operates when the underload level condition explained above is maintained for a set warning time or fault trip time. This function does not operate if energy–saving operation is activated at Ad.50 (E–Save Mode).
Pr.29 UL LF Level, Pr.30 UL BF Level	Setting Heavy Duty – Do not support Pr.29. – At Pr.30, the underload level is decided based on the motor's rated current.

Fan Fault Detection

Pr. Group	Pr. Code	Name	LCD Display	Parameter Setting		Setting range	Unit
Pr	79	Cooling fan fault selection	FAN Trip Mode	0		Trip	–
OU	31	Multi–function relay 1	Relay 1	8	FAN Warning	–	–
OU	33	Multi–function output 1	Q1 Define				

Fan Fault Detection Setting Details

Pr. Code	Description		
Pr.79 FAN Trip Mode	Set the cooling fan fault mode.		
	Setting		Function
	0	Trip	The drive output is blocked and the fan trip is displayed when a cooling fan error is detected.
	1	Warning	When OU.33 (Q1 Define) and OU.31 (Relay1) are set to 8 (FAN Warning), the fan error signal is output and the operation continues.
OU.33 Q1 Define, OU.31 Relay1 (A1, B1, C1 terminals)	When the code value is set to 8 (FAN Warning), the fan error signal is output and operation continues. However, when the drive inside temperature rises above a certain level, output is blocked due to activation of overheat protection.		

Low Voltage Fault Trip

When drive input power is lost and the internal DC link voltage drops below a certain voltage level, the drive stops output and a low voltage trip occurs.

Pr. Group	Pr. Code	Name	LCD Display	Parameter Setting		Setting range	Unit
Pr	81	Low voltage trip decision delay time	LVT Delay	0.0		0–60	sec
OU	31	Multi–function relay 1	Relay 1	11	Low Voltage	–	–
	33	Multi–function output 1	Q1 Define				

Low Voltage Fault Trip Setting Details

Pr. Code	Description
Pr.81 LVT Delay	If the code value is set to 11 (Low Voltage), the drive stops the output first when a low voltage trip condition arises, then a fault trip occurs after the low voltage trip decision time is passed. The warning signal for a low voltage fault trip can be provided using the multi–function output or a relay. However, the low voltage trip delay time (LVT Delay time) does not apply to warning signals.

Output Block by Multi–Function Terminal

When the multi–function input terminal is set as the output block signal terminal and the signal is input to the terminal, then the operation stops.

Pr. Group	Pr. Code	Name	LCD Display	Parameter Setting		Setting range	Unit
In	65–69	Px terminal setting options	Px Define(Px: P1–P5)	5	BX	0–54	–

Output Block by Multi–Function Terminal Setting Details

Pr. Code	Description
In.65–69 Px Define	When the operation of the multi–function input terminal is set to 5 (BX) and is turned on during operation, the drive blocks the output and 'BX' is displayed on the keypad display. While 'BX' is displayed on the keypad screen, the drive's operation information including the operation frequency and current at the time of BX signal can be monitored. The drive resumes operation when the BX terminal turns off and operation command is input.

Trip Status Reset

Restart the drive using the keypad or analog input terminal, to reset the trip status.

Pr. Group	Pr. Code	Name	LCD Display	Parameter Setting		Setting range	Unit
In	65–69	Px terminal setting options	Px Define(Px: P1–P5)	3	RST	0–54	–

Trip Status Reset Setting Details

Pr. Code	Description
In.65–69 Px Define	Press [Stop/Reset] key on the keypad or use the multi–function input terminal to restart the drive. Set the multi–function input terminal to 3 (RST) and turn on the terminal to reset the trip status.

Drive Diagnosis State

Check the diagnosis of components or devices for drive to check if they need to be replaced.

Pr. Group	Pr. Code	Name	LCD Display	Parameter Setting	Setting Range		Unit
Pr	89	CAP, FAN replacement warning	Drive State	–	Bit	00–10	Bit
					00	–	
					01	CAP Warning	
					10	FAN Warning	
*See "Bit Selection" on page 4–3 for details							

Operation Mode on Option Card Trip

Option card trips may occur when an option card is used with the drive. Set the operation mode for the drive when a communication error occurs between the option card and the drive body, or when the option card is detached during operation.

Pr. Group	Pr. Code	Name	LCD Display	Parameter Setting		Setting range	Unit
Pr	80	Operation mode on option card trip	Opt Trip Mode	0	None	0–3	–
				1	Free–Run		
				2	Dec		

Operation Mode on Option Trip Setting Details

Pr. Code	Description		
Pr.80 Opt Trip Mode	Setting		Function
	0	None	No operation
	1	Free–Run	The drive output is blocked and fault trip information is shown on the keypad.
	2	Dec	The motor decelerates to the value set at Pr.7 (Trip Dec Time).

No Motor Trip

If an operation command is run when the motor is disconnected from the drive output terminal, a 'no motor trip' occurs and a protective operation is performed by the system.

Pr. Group	Pr. Code	Name	LCD Display	Parameter Setting		Setting range	Unit
Pr	31	Operation on no motor trip	No Motor Trip	0	None	–	–
	32	No motor trip current level	No Motor Level	5		1–100	%
	33	No motor detection time	No Motor Time	3.0		0.1–10	s

No Motor Trip Setting Details

Pr. Code	Description
Pr.32 No Motor Level, Pr.33 No Motor Time	If the output current value [based on the rated current (bA.13)] is lower than the value set at Pr.32 (No Motor Level), and if this continues for the time set at Pr.33 (No Motor Time), a 'no motor trip' occurs.

CAUTION: If bA.7 (V/F Pattern) is set to 1 (Square), set Pr.32 (No Motor Level) to a value lower than the factory default. Otherwise, 'no motor trip' due to a lack of output current will result when the 'no motor trip' operation is set.

Low voltage trip 2

If you set the Pr.82 (LV2 Selection) code to 1 (Yes), the trip notification is displayed when a low voltage trip occurs. In this case, even if the voltage of the DC Link bus is higher than the trip level, the LV2 trip will remain active. To reset the trip, reset the drive. The trip history will not be saved.

Pr. Group	Pr. Code	Name	LCD Display	Parameter Setting	Setting Range	Unit
Pr	82	LV2 Selection	LV2 Enable	1: Yes	0/1	–

Fault/Warning List

The following list shows the types of faults and warnings that can occur while using the ACN drive. Please refer to "Learning Protection Features" on page 4–198 for details about faults and warnings. Further detail on faults and warnings are included in Chapter 6: Maintenance and Troubleshooting on page 6–1

Category		LCD Display	Details
Major fault	***Latch type***	Over Current1	Over current trip
		Over Voltage	Over voltage trip
		External Trip	Trip due to an external signal
		NTC Open	Temperature sensor fault trip
		Over Current2	ARM short current fault trip
		Option Trip–x*	Option fault trip*
		Over Heat	Over heat fault trip
		Out Phase Open	Output open–phase fault trip
		In Phase Open	Input open–phase fault trip
		Drive OLT	Drive overload fault trip
		Ground Trip	Ground fault trip
		Fan Trip	Fan fault trip
		E–Thermal	Motor overheat fault trip
		Pre–PID Fail	Pre–PID operation failure
		IO Board Trip	IO Board connection fault trip
		Ext–Brake	External brake fault trip
		No Motor Trip	No motor fault trip
		Low Voltage 2	Low voltage fault trip during operation
		ParaWrite Trip**	Write parameter fault trip
	Level type	Low Voltage	Low voltage fault trip
		BX	Emergency stop fault trip
		Lost Command	Command loss trip
		Safety A(B) Err	Safety A(B) contact trip
	Hardware damage	EEP Err	External memory error
		ADC Off Set	Analog input error
		Watch Dog–1	CPU Watch Dog fault trip
		Watch Dog–2	
Minor fault		Over Load	Motor overload fault trip
		Under load	Motor underload fault trip
Warning		Lost Command	Command loss fault trip warning
		Over Load	Overload warning
		Under Load	Under load warning
		Inverter OLT	Drive overload warning
		Fan Warning	Fan operation warning
		DB Warn %ED	Braking resistor braking rate warning
		Retry Tr Tune	Rotor time constant tuning error
		CAP Exchange	Capacitor replacement warning
		FAN Exchange	Fan replacement warning

** Applies only when an option board is used.*
*** Displayed on an ACN-LCD keypad only.*